Nicolas Schöffer and the Scattered Origins of Cybernetic Art History

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Abstract

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Cybernetics appeared first in America in the 1940s and '50s as an experimental scientific field, which attempted to understand networked systems through studying channels of feedback and communication. However, its relevance to the period was quickly felt beyond its first home in mathematics, including by some in the plastic arts. French-Hungarian artist Nicolas Schöffer (1912-1992) is the first artist documented as incorporating cybernetic principles into modern art. With the help of engineers, he was able to develop new responsive technologies to realize his artistic vision. The resulting cybernetic artworks, built to respond to their environments in various ways, are defining examples within the history of art, science, and technology collaboration.

This thesis uses a selection of Schöffer's sculptural cybernetic works originally produced between 1950 and 1970 as case studies for the unique materiality of responsive machine art, and considers how cybernetics impacted the foundations of art and technology discourse. The author invokes Schöffer's art as a tool for navigating broader methodological questions: What does the content of cybernetic art have to teach us about writing and history? And, how can we write about machines more accurately and responsibly? The shifting material lives of Schöffer's cybernetic artworks are analyzed alongside past and present studies of them, demonstrating one approach to understanding the rhetorical complexity of cybernetic art history and what its significance might be today.

Acknowledgments

Deepest thanks to Dr. Nicola Pezolet, my supervisor, whose patience is unyielding and whose ongoing feedback and support kept me tethered to the ground. In our first meeting we watched a futuristic Brigitte Bardot perform alongside Nicolas Schöffer's robots and I couldn't have imagined a better place to start exploring my cybernetic curiosities in art history—still can't.

Thank you to the Department of Art History's faculty, fellow students, and administrators for their kindness and encouragement on numerous occasions throughout my time at Concordia. Special thanks to Dr. Johanne Sloan, who unknowingly began contributing to the making of this thesis well before graciously acting as its reader, and Dr. Heather Igloliorte, who has made me a better writer, thinker, and person.

The generosity of Éléonore de Lavandeyra Schöffer with both her time and stories is sincerely appreciated, and meeting her was the highlight of doing this research.

Dan, you're all over this thing. Thanks for being a brilliant partner in life and, more importantly, in conversation.

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Introduction: Writing the Program

Since the 1960s, there has been an influx of interdisciplinary approaches intended to ascribe new meaning to technological things. Feminist technoscience interrogates fundamental categorizations of matter – human or nonhuman, living or not, with language or without – and rewrites the ongoing history of science and technology in a way that highlights the political dimensions of particles. From a more technical perspective, media archaeology looks at the material lives of everyday machines, such as game consoles, mobile phones, and televisions. Elsewhere, in communications theory, our relationships to our technologies are extended and entwined with the domain of natural environments and ecologies, under what scholar John Durham Peters calls "a philosophy of elemental media."[1] One shared trait among these examples is an interest in how the shifting material conditions of technological objects impact their creation, distribution, and reception. In this thesis, focused on the work of French-Hungarian artist Nicolas Schöffer, I concern myself with the study of technological things in art history. Grounded in the material conditions of Schöffer's machines, I search for insights through a particularly critical period not only for the history of art, but the histories of science and technology, as well as "art, science, and technology" as its own interdisciplinary field of inquiry.

The emergence of cybernetics in the United States in the 1940s, and its resounding impact internationally, was a breakthrough on our path to contemporary computation. Though cybernetics as a field is practiced less frequently today, displaced from the mainstream due to its bad record of political and governmental implementations, its influence can be felt in the ways we relate to our machines, such as through the various contemporary approaches just mentioned. Cybernetics also marked the earliest days of interdisciplinary developments between the arts/humanities and science/technology sectors, making it an apt place to start a discussion of a historiographical or methodological nature. It is here where I would like to focus this inquiry into cybernetic art history on one artist, and the methods used by art, science, and technology historians in their studies of him. Schöffer and his cybernetic sculptures and towers represent one of the first and most curious cases of mischaracterized machines in art history.

Nicolas Schöffer was born in 1912 in Hungary, and following the lead of his father, a lawyer, studied law before moving to Paris in 1936 and becoming progressively involved in the

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[1] John Durham Peters, *The Marvelous Clouds: Toward a Philosophy of Elemental Media* (Chicago: University of Chicago Press, 2015), 1.

arts scene there. In the early 1940s, Schöffer was in Paris meeting influential figures in modern art, notably including another influential French-Hungarian artist, Victor Vasarely.[2] As an artist on the front lines of Op Art's development in Europe, Vasarely's influence on Schöffer is one of many possible factors in Schöffer's frequent association with modern kinetic art. Both artists were represented by Denise René's gallery, and they exhibited together as masters of the medium.[3] But as early as 1943, Arnauld Pierre writes, "Schöffer's notebooks are filled with entries reflecting his scientific interests."[4] Although there was an undercurrent of scientific curiosity to many types of kinetic art, Schöffer was working toward something altogether different. After working for years as a painter, Schöffer began writing about his original concept of spatiodynamism in 1948, subsequently applying it to a new focus in sculpture and publishing a book (the first of several) on the subject in 1954. At its core, spatiodynamism is about elevating sculpture to new heights by giving it increased presence in space and time, which might be achieved a variety of ways, as Schöffer's eclectic repertoire illustrates. Spatiodynamic sculpture could be static or in motion, examples of the former seen in the artist's *Spatiodynamique*, *Chronos*, and *Lux* sculpture series from the 1950s, '60s, and '70s respectively—which, though not cybernetic, were often being created in tandem with the larger mobile works and could be considered as studies, in addition to being considered on their own terms. Indeed, Schöffer's concept of spatiodynamism is best realized in public space, where sculpture contributes to social life. In *Le nouvel esprit artistique*, published in 1970, Schöffer defines spatiodynamic sculpture as an aesthetic phenomenon in its own right, determining that "[t]his aesthetic function of the sculpture also explains why this art, intended especially for the outside world, fulfills a real social role."[5] In 1955, Schöffer unveiled the first of his spatiodynamic collaborations with the Philips Corporation in the form of a temporary cybernetic tower installed in Parc de Saint Cloud. This would be one of the first works to bring together his interest in science and his theories of spatiodynamism. Schöffer's machines had exceeded the threshold of engagement in kinetic art; they are some of the first successful iterations of cybernetic machines that demonstrated an adaptive, responsive, and reciprocal relationship with an environment.

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[2] Biographical notes taken from Arnauld Pierre, Arnauld Pierre, Dominique Trudel, and Pauline Mari, *Nicolas Schöffer* (Brussels: Mercatorfonds, 2018), 216-222.

[3] John Canaday, "At the Galleries: Schöffer and Vasarely; Masters of Kinetic and Op Art Are Now On View," *New York Times,* January 13 1968, 27.

[4] Pierre, Trudel, and Mari, *Nicolas Schöffer,* 217.

[5] Nicolas Schöffer, *Le nouvel esprit artistique* (Paris: Denöel/Gonthier, 1970), 80. Translation my own.

Schöffer and Jacques Bureau, the Philips engineer who designed the technological component of the artist's works, introduced their next project in 1956: a responsive and mobile sculpture named *CYSP 1. CYSP 1* takes half its name, "CY" from cybernetics; the second half, "SP," from spatiodynamism. That same year, mathematician Norbert Wiener published his book *Cybernetics, or Control and Communication in the Animal and the Machine*, an explication, theoretical and scientific, of how computing machines mimic the human nervous system and synaptic responses. Schöffer was at a geographical distance from cybernetics' home base in the United States, where, over the course of the 1940s and '50s, scholars from a range of fields came together at the Macy Conferences in New York to define this new discipline.[6] Nonetheless, with the help of Philips engineers he was one of the first to integrate early feedback mechanisms, which mimicked British cyberneticist Ross Ashby's homeostat, into a real robot. Schöffer continued to experiment with cybernetics through the 1950s, and although his work progressed in different directions in the years to follow, taking form as a colour organ, interactive pedagogical tools for children, and large-scale theatrical performances, Schöffer continued to integrate cybernetic principles into his projects. Schöffer's work indicates, as does the work of many others, that the main concerns of cybernetics – "control and communication in the animal and the machine" – are suited to applications beyond Wiener's initial intentions when he wrote cybernetics' defining text. Since the word was first used in the summer of 1947, one year prior to the publication of Wiener's book,[7] there have been distinct "waves" of cybernetic research in the United States and internationally,[8] each with their own priorities, as well as efforts by select scholars to argue cybernetics as a broad analytical framework. Contemporary historian of science Andrew Pickering features the British cyberneticians in his book *The Cybernetic Brain: Sketches of Another Future*, highlighting their creative uses of cybernetic science; Gordon Pask, a scientist and contemporary of Schöffer's who exhibited with the artist in the 1968 exhibition *Cybernetic Serendipity*, is one of Pickering's main subjects.[9] Pointing to Pask's artistic endeavors and others

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[6] In 2016 the University of Chicago Press published the transcripts of the 1946-1953 Macy Conferences. See Claude Pias, ed. *Cybernetics / The Macy Conferences 1946-1953. The Complete Transactions* (Zurich: Diaphanes, 2016).

[7] Norbert Wiener, *Cybernetics, or Control and Communication in the Animal and the Machine,* 2nd ed. (Cambridge: MIT Press, 1985 [1948]), 12.

[8] See Katherine Hayles, "Boundary Disputes: Homeostasis, Reflexivity, and the Foundations of Cybernetics," *Configurations* 2, no. 3 (1994).

[9] Andrew Pickering, *The Cybernetic Brain: Sketches of Another Future* (Chicago: University of Chicago Press, 2010), 309-378.

as case studies, Pickering emphasizes that cybernetics, though used in the past for militarist and anti-humanist ends, also operates alongside a certain unknowability in the world that the traditional scientific method problematically and conveniently denied, or, in the best of cases, just ignored.[10] Perhaps this is why it appealed both to those trained in the sciences and in the arts, and allowed for the type of cross-disciplinary presentation found at *Cybernetic Serendipity*. Intent on simulating response, cybernetic machines require an open-endedness and capacity to adapt, because communication is not fixed, but unfolding; not one-sided, but reciprocal; not of history, but a property of real time, past and future. The cyborg is therefore bound to notions of reciprocity, and meaning generated of that reciprocity, between animals, machines, and their shared environments.

In some respects, Schöffer's creative practice, concerned firstly with how humans and machines collaborate toward a product, was decidedly ahead of its time. In other respects, particularly in Schöffer's modern rhetorical strategies that relied on the assertion of his own artistic genius and assumptions about his human subjects, his work feels outdated—especially when placed alongside more contemporary examples of robotic arts. Even more unfortunate, Schöffer willingly associated himself with cybernetics' darkest iterations, including its application to theories around biological control and "the modification of man by man."[11] There is not a lot of evidence to suggest where Schöffer aligned himself politically, but his involvement in urban renewal efforts in Paris and his belief in the aestheticization of space as a moral imperative for contemporary society do politicize his practice beyond the more reductive lines of political affiliation. Here, I am interested in parsing these different aspects of Schöffer's practice and using his artwork as a vehicle for thinking through the specific qualities of cybernetic art and the failure of art history to adequately account for these qualities. The more challenging parts of studying Schöffer's work are tied up in his politics as an artist, but the benefits of studying his work might be such that the machinic works of contemporary artists become more transparent and accessible to today's scholars, who have been left without an adequate methodological toolkit for their research. This thesis therefore seeks to apply a materialist, historiographical framework, which emphasizes what the material status of objects can teach us about

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[10] Pickering works through this in the second chapter of his book, titled "Ontological Theater." See Pickering, *The Cybernetic Brain: Sketches of Another Future,* 17-37.

[11] Schöffer's *La ville cybernétique* quoted by Hervé Vanel in "Cybernetic Bordello: Nicolas Schöffer's Aesthetic Hygiene," in *France and the Visual Arts Since 1945: Remapping European Postwar and Contemporary Art,* ed. Catherine Dossin (London and New York: Bloomsbury, 2018), 113.

accountability—specifically, writers' accountability to the objects we write about. To demonstrate, I present the material realities of Schöffer's cybernetic works alongside written accounts of them, which, I argue, generally look past the lessons these objects might teach us about themselves in order to fit them into history's existing categories.

Before outlining main components of this thesis, a brief note on the meaning of materiality in the context of my research and cybernetic art history may be useful in order to better define a materialist historiography. In my opening statements, I point to examples of how interdisciplinarity has been fundamental to developing technological discourse in the humanities. Current interdisciplinary approaches to technology, such as feminist technoscience and media archaeology, are supported in part by another young field called new materialism. New materialism is not dedicated exclusively to science and technology, distinguishing it from the aforementioned examples, but several of its key figures nonetheless focus on exchanges between biological and technological bodies, including for example Karen Barad and Rosi Braidotti.[12] The online, peer-reviewed project *criticalposthumanism.net,* which includes scholars from a wide range of disciplines whose work has shaped the posthuman turn in the humanities (and for which Braidotti serves as an advisor), also identifies new materialism as a significant part of their collective efforts to disrupt established hierarchies between living and non-living beings. Although this thesis is focused on the language used by cyberneticians and those documenting cybernetics, the perspective on materiality put forward by new materialism is quietly present throughout my analysis—namely, that nonhuman agency must be recognized alongside human agency, and that the interactivity of matter is bound up with ethical responsibility. As one of new materialism's pre-eminent figures, Jane Bennett, articulates: "The ethical task at hand here is to cultivate the ability to discern nonhuman vitality, to become perceptually open to it."[13] In conceiving of a materialist historiography, the intention is to become more open to the material lives of things by creating space in writing and history for their "vitality," following Bennett; that is, allowing for the increased vitality of writing itself.

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[12] See, for example, Rosi Braidotti, "A Theoretical Framework for the Critical Posthumanities," special issue, *Theory, Culture, and Society* (2018): 1-31; also Karen Barad, "Quantum Entanglements and Hauntological Relations of Inheritance: Dis/continuities, SpaceTime Enfoldings, and Justice-to-Come," *Derrida Today* 3, no. 2 (2010): 240-268.

[13] Jane Bennett, *Vibrant Matter: A Political Ecology of Things* (Durham, NC: Duke University Press, 2010), 14.

In part one, "Between Envisioning and Versioning," I take up three material stages embodied by Schöffer's machines while considering how these stages reflect the qualities of machine art that make it difficult to document and archive accurately. Some of Schöffer's cybernetic works, for example, existed either temporarily or solely in sketches and letters. This was in part due to their large scale and reliance on external institutional support, collaborators, and participants. They also implemented technology built by engineers, and could not, at the time, reasonably be brought to the masses (as was the artist's intention for many of his smaller objects). Others are permanent and still functional today, but have undergone major physical changes during their restoration. The ongoing maintenance required to keep Schöffer's machines running poses another problem for those who document them, and this is a problem that still persists today. When we talk about machinic work in the contemporary sense – and especially from the position of a collector, a curator, an institution – we are talking about works that require significant amounts of maintenance, and sometimes specialized knowledge, to run. In 1966, curators at the Washington Gallery of Modern Art, where Schöffer's two-person exhibition with Jean Tinguely had travelled, state that the exhibition made them realize "for a show like this a good maintenance man is as important as a good curator."[14] The notion of a technological work of art remaining open, unfinished, and sketchy are not indicative of failure, however; quite oppositely, these qualities define the genre.[15] This almost guaranteed and fiercely material relationship to failure is precisely what facilitates experimental methodological approaches that de-hierarchize singular, fixed objecthood. By diving into the various material states of Schöffer's cybernetic projects, I lay the groundwork for a discussion about the role language plays in Schöffer's legacy and the continuation of art, science, and technology collaboration.

In part two, "Reconciling Media and Matter on the Margins," I look at examples of critical art writing about Schöffer's work, both contemporary and historical. Looking at how Schöffer's history relates to cybernetic and art histories, I consider the vocabularies of art, science, and technology as they play out in the artist's practice and use these examples to illustrate long-standing tendencies to conflate the material status of machines with their social or cultural status. There is an undeniable mysticism surrounding Schöffer's technology for many

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[14] David Bourdon, "A good janitor becomes as important as a curator," *Life* 61, no. 7 (1966): 47.
[15] I first discussed this idea of a "sketchy machine" in a short article from 2018. See Lindsay LeBlanc, "Sketchy Machines: Propositions Around Three Robotic Artworks," *esse arts + opinions* 93 (Spring/Summer 2018): 50-57.

critics, who further obscure the inner workings of Schöffer's machines in favour of 'Black Box' logic, where the input and the output or result of a feedback loop are identified, but the passage from one to the other is not. This is not necessarily a circumstance of fault – it is a critics' job to be mystified by art, and describe this experience to a reader – but a circumstance that has resulted in an incomplete art history, and a tendency held among both critics and historians to prioritize the symbolic and visual content of machines over their inner workings, their specificity. Yet interpretive exercises can rarely identify and account for the very nervous systems[16] of machines. By reviewing the available literature, I intend to use Schöffer's history – as it collides, layers, overlaps, entangles with cybernetic art history and media art history more broadly – as a space where critique can make ground more fertile for emergent approaches. The conclusion begins to plant seeds in this broken ground, suggesting that cybernetics, as an ongoing field of inquiry, is not conducive to describing a category of objects. Cybernetics does, however, point to a set of questions, concerns, and priorities shared by responsive machine objects—the beginnings of a methodology for writing media today.

The two main parts of this thesis are about Nicolas Schöffer and a specific context in the history of art, science, and technology, but they share an aim to develop more useful and coherent methodological tools for understanding machines through their materiality. Schöffer's case shows the necessity of developing new strategies for writing through complication, the noise, the error message. How does one pursue a study of errors? This question, for me, recalls one of the initial points made in Montreal-based artist Rafael Lozano-Hemmer's didactic GitHub text, "Best Practices for Conservation of Media Art from an Artist's Perspective":

> Mistrust anyone who has a "method" for conservation of Media Art.
> Anyone, such as myself, who offers a set of rules is someone who is not
> considering the vast range of disparate experiences, methods, constraints
> and dependencies that can arise even within the work of a single artist.
> All we can do is suggest a bunch of tips, wait for an artist to prove those
> tips useless, and then review the tips.[17]

The same must be true for media art history, an area so broad that it includes everything from Schöffer's mid-century robots to twenty-first century performance artists experimenting with

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[16] This phrase is borrowed from the title of an artwork by Canadian media artist David Rokeby.
[17] Rafael Lozano-Hemmer, "Best practices for the conservation of media art from an artist's perspective," *GitHub*, September 28, 2015, https://github.com/antimodular/Best-practices-for-conservation-of-media-art.

portraiture on Instagram. As Andrew Pickering writes: "In the academic world, it is precisely scholars who feel the shortcomings of the modern disciplines who are attracted most to the image of the 'cyborg'—the cybernetic organism—as a nonmodern unit of analysis (with Haraway 1985 as a key text)."[18] In the short conclusion I attempt to bridge the first and second parts of this thesis into the speculative beginnings of a methodology for the interdisciplinary media art historian. Due to its disposition toward the reciprocal, material circumstances of humans and machines, as well as its interdisciplinary origins, cybernetics has unique potential to provide rhetorical tools that might help us critically assess the difference across media art objects, in terms of both their practical and symbolic existence. I do not see it as a coincidence that the first robotic artworks were labelled "cybernetic" by their maker, and that the literature of cybernetics was a factor in their creation, which was itself fundamental to the development of technological art in the years to come. But in order to satisfy the ethical obligations of today's researchers, cybernetics must also be called upon to recognize difference in machines as it projects onto human bodies. It must be reconciled with our collective responsibility to incorporate decolonizing and other equalizing strategies into current methodologies. As would hypothetically be true with any truly cybernetic approach, the concluding section of this thesis is unfinished, and should be seen only as a sketch of what a methodological frame for media art history could be. The hope, of course, would be to see these tips one day proven useless.

I Between Envisioning and Versioning
Three Material Stages of Schöffer's Machines

In March of 2018 I wrote a short piece about three robotic artworks for the Montreal-based magazine *esse*, responding to the theme "sketch". In the piece, I observe what I call a "sketchy materiality" across these artworks, by three different artists, in an effort to highlight the inherently unfinished nature of technological art. Even when machine art is brought into existence, it is assumed that it cannot continue to function, unattended, forever (usually due to eventual incompatibility between software and hardware, where the former is constantly outrunning the latter). In some cases, media artists make this apparent when they leave the date of their work open-ended by providing only a start date with an open dash (e.g. 1990-) to indicate the work is still in-progress. This distinguishes technological art from more traditional

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[18] Pickering, *Cybernetic Brain*, 18.

media, such as painting or sculpture, which, even taking conservation needs into account, can be left unattended for years at a time—making it remarkably low maintenance by comparison.

Schöffer sets the example, as one of media art's originary figures. His art and architectural works defy the idea of an object existing as a complete, impenetrable whole. They also defy categorization, fitting convincingly into the realms of sculpture, installation, architecture, robotics, instruments, and educational tools. The openness with which Schöffer approached his practice also comes through in his writing, and especially his namesake claim that his goal as an artist was not to create, but to create creation.[19] Though Schöffer was susceptible to the modern rhetoric of creator-as-god[20] (and his insistent use of "create" and its derivatives, as opposed to one of its many synonyms, does recall the rhetoric of an ultimate Creator), he was fascinated by the possibility of the object acting as a creator in itself. In this way, Schöffer had an on-again, off-again relationship with the myth of the artistic genius. Without overlooking the problematic aspects of Schöffer's choice of vocabulary, I argue here that the artist's interest lay in the design and implementation of a set of conditions that are conducive to growth – precisely what all technological work requires to endure rapid change in the industry – rather than the preservation of a static, enduring object. He dedicated several books to the notion that artwork benefited from an adaptability that would allow it to withstand an ongoing generative function, including the 1969 publication of *La ville cybernétique*, 1970's *Le nouvel esprit artistique*, and 1978's *Perturbation et chronocratie*, among others. And he believed, rightly so, that adaptability could be achieved through programmed machines.

Schöffer's art and architecture embodied many of his ideals, even shaped them; most of his books were published after the period of most remarkable development in his work. This is particularly true of his cybernetic art and architectural works, taking form primarily in large-scale public towers. Schöffer's mission to activate sculpture through spatiodynamic principles is tangibly achieved by his cybernetic works, whose relationship to space and time is not only represented through a symbolic dynamism, but an active integration with their environment. Through an analysis of the distinct, sketchy materialities of these machines, built in a period

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[19] This quotation, originally written in French as "le rôle de l'artiste n'est plus de créer une oeuvre mais de créer la creation," appears first in *Le nouvel esprit artistique*, and is frequently repeated throughout literature on the artist.

[20] Discussed by the artist in a 1966 text reprinted as "Nicolas Schöffer: Microtime," in *Directions in Art, Theory, and Aesthetics,* ed. Anthony Hill, 150-153 (London: Faber and Faber, 1968), 153. He elaborates in the 1969 *La ville cybernétique.*

from approximately 1950 to 1970, a set of critical questions organically emerges. By no coincidence, these questions are echoed throughout early papers on cybernetics. In bringing these questions to the fore, my aim is to propose that the material circumstances of Schöffer's artwork point to how we should write about it: namely, in a way that is open-ended, and allows historians to pinpoint the precise materiality of the object while understanding its broader social and cultural implications. In the case of Schöffer, I argue, there are three particular material stages his artworks occupied (and continue to occupy) that might lead us to this equally open-ended and yet specific approach to history: unbuilt, temporary, and restored. Each of these stages, as I refer to them – largely in an effort to mirror Schöffer's interest in art that evolves over time – are generative, literally and rhetorically, with creative origins in dialogue and feedback.

For Schöffer's artistic machines, the question of what kinds of responses they might produce was always preceded by the question of who would be building them in the first place. The technology Schöffer sought to integrate into his artworks was not accessible to the masses, and in some cases, actually had to be invented for his unique purposes, as was the case with his cybernetic, generative works, which were produced in collaboration with Jacques Bureau, an engineer from Philips Société Anonyme.[21] Schöffer's collaboration with Bureau and Philips is nearly exclusively framed by Schöffer and his historians, except for an occasional note from Bureau, only one of which has been officially published.[22] There is also limited description as to how their collaboration came to be, but it did have clear promotional value for Philips (they were in fact responsible for promotional materials),[23] and allowed technological innovation and artistic innovation to occur in tandem. Schöffer's first cybernetic work on record is the *Tour Spatiodynamique, Cybernétique et Sonore*, built in 1955 for the Salon International des Travaux Publics et du Bâtiment at Parc du Domaine de Saint-Cloud, in a suburb of Paris. This was also the first of Schöffer's projects worked on by Bureau. "With things going so well, Schöffer and Philips were not about to call it a day,"[24] writes Arnauld Pierre; Schöffer would call on Bureau again during the development of the 1956 sculpture *CYSP 1*, which would be the second version of the "electronic brain" that motivated Schöffer's machines. Referring to Bureau's notes on

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[21] Commonly referred to as the more general Philips, Philips Corporation, or Philips Company Europe. Philips Société Anonyme is specified by Frédéric Schnee in "Towards Dematerialization," *ARPA Journal* 5, May 24, 2018, http://www.arpajournal.net/towards-dematerialization/.

[22] See Guy Habasque and Jacques Ménétrier, *Nicolas Schöffer*, trans. Haakon Chevalier (Neuchâtel: Editions du Griffon, 1963), 45.

[23] Pierre, Trudel, and Mari, *Nicolas Schöffer,* 66.

[24] Pierre, Trudel, and Mari, *Nicolas Schöffer,* 67.

CYSP 1 and calling out his use of the term "electronic animals," Pierre considers that "The reference to electronic animals is of crucial significance. It places *CYSP 1* in the conceptual and technological tradition of the zoomorphic robots created in the early days of robotics—an area in which the firm of Philips had played a pioneering role."[25] Pierre suggests here that *CYSP 1* was not necessarily a departure for Philips; and in their promotion of the robot, they made efforts to use language that could be connected back to their existing profile. Schöffer's mission fit neatly within a broader context of technological industry. Philips continued working with Schöffer. Five years later, in 1961, the *Tour Spatiodynamique et Cybernétique de Liège* was erected including the "electronic brain"[26] technology. It was the first of Schöffer's cybernetic towers to be permanently installed, as a public, site-specific artwork, and in 2010 it was restored by an architectural firm in Liège. In the sections to follow, representing different versions of Schöffer's cybernetic art and architecture, each of these artworks will serve as illustrations supporting the generative, unfinished, open-ended, sketchy materialities of machinic art.

1 (v.1) Unbuilt

In 1969, Schöffer published *La ville cybernétique*—a city plan and theoretical treatise for an urban, technological utopia, which, in addition to including some widely familiar buildings (domestic residences, a scientific research centre, a university) hosted some less recognizable buildings, too. Perhaps the most novel of these is the sexual entertainment and leisure centre, shaped in the form of a breast and filled with abstract, organic sculptures alongside Schöffer's mechanical-looking objects.[27] (Fig. 1) Another, which has come up more frequently in writing about the artist's practice, is the "spatiodynamic theatre": an adaptable theatre space designed to host programming "composed of multiple and simultaneous elements," such as rotating seating, electronic sculpture, and cinematic projection.[28] (Fig. 2) (Schöffer's theatre also recalls Gordon Pask's "Proposals for a Cybernetic Theatre" in 1964.)[29] Predictably, the artist would place his

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[25] Pierre goes on to write, "As early as 1928, one of its engineers, Henri Piraux, had created Philidog, an 'electric dog' that was able to respond to its mater's flashlight commands thanks to optic sensors fitted (and positioned) in place of eyes. Of more advanced design were the famous 'electronic tortoises' created in the late 1940s by the British neurologist and cybernetician William Grey Walter." See Pierre, Trudel, and Mari, *Nicolas Schöffer,* 69.

[26] This name was originally given to the device by Philips in their marketing.

[27] Nicolas Schöffer, *La ville cybernétique* (Paris: Denöel/Gonthier, 1969), 97.

[28] Habasque and Ménétrier, *Nicolas Schöffer*, 128.

[29] Gordon Pask, "Proposals for a Cybernetic Theatre" (text produced for "Theatre Workshop and Systems

cybernetic towers throughout his city, and as an annex to his text included detailed description and formulaic, mathematical plans for one tower in particular: the 307-metre[30] *Tour Lumière Cybernétique de Paris*. The tower was intended by Schöffer and Paris city officials to be built at La Défense as part of a redevelopment project for the area,[31] and it was thoroughly documented in several drawings and physical models through the 1960s and early '70s. The tower at La Défense was ultimately never built, just as the cybernetic city was left unrealized—but these two projects nonetheless have things to tell us about Schöffer's artistic program.

Art historian Hervé Vanel notes that "Schöffer's eagerness to impose his art upon society finds its roots in the postwar ideal of a 'synthesis of the arts' (*synthèse des arts*)."[32] Artists who shared in this ideal, such as the members of Groupe Espace (which Schöffer was a member of), believed art's role was to shape public space and, by association, public life. Schöffer's approach to synthesis through cybernetics distinguished itself from the postwar trend by exceeding any prior relationship held between artworks and their environments. Featuring Schöffer's responsive machines and buildings that were based around his artistic principles, *La ville cybernétique* promoted the notion that in the future, urban environments would actively respond to their inhabitants and establish a constant feedback loop between living beings and the spaces they occupy. This concept is still of equal, if not increased relevance, in the twenty-first century, where technology is routinely being deployed with various levels of invisibility in domestic and public spaces. Schöffer's book based on postwar ideals does not account for the perversions of technological environments to cultivate areas of intense surveillance and data mining, which is how we might view a similarly ambitious project today. Technological utopias are rapidly turning into technological dystopias. Even Schöffer's idealistic visions for cybernetics already represent a sort of dystopia to some because of his closeness to capitalist industry and technocratic planning. Schöffer's relationship with industry was more complicated and potentially problematic than the artist would ever directly admit, preferring to use "opaque and speculative prose"[33] in writing about his own work. In his constant pursuit of integrating his

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Research," 1964), http://pangaro.com/pask/ProposalCyberneticTheatrePask1964r.pdf.
  [30] Information about this tower is contested; Dominique Trudel has pointed out that the height of the Cybernetic Light Tower has been documented as 307 and 347 metres, which actually reflect different stages of the artwork's planning. See Pierre, Trudel, and Mari, *Nicolas Schöffer*, 196.
  [31] Pierre, Trudel, and Mari, *Nicolas Schöffer,* 196.
  [32] Vanel, "Cybernetic Bordello," 110.
  [33] Vanel, "Cybernetic Bordello," 112.

work into public space (or, in the case of his smaller objects, integrating into mass market[34]), he strongly desired to appeal to the public – if only to implicate the masses in his dream of cybernetic life – and would take corporate money to do so, seeing no reason for isolating himself as an artist. Schöffer said to Philippe Sers in 1971: "Free and master of my work, the company having the choice to give me means or not. It is a collaboration of a new type which, in my opinion, foreshadows the one to come between the artist and big companies or the state. Only then can he (the artist) can come to terms with himself, there is no other solution."[35] The conceptual grouping of big companies and the state, here, may already point down insidious paths, particularly when relating Schöffer's less direct writing with the much more directly stated aims of Norbert Wiener's cybernetics to operate at the level of population management and societal governance. Schöffer would use similarly coded language in his 1954 Néovision manifesto, stating the suppression of anarchy as his goal and "inevitably evoking an absence of governmental control."[36] Drawing on Benjamin Buchloch's historical criticism, Yates McKee writes in 2008: "Schöffer's projected towers retooled Vladimir Tatlin's Monument to the Third International for the era of cybernetic planning in which the representatives of the people are replaced by automated, real-time monitoring systems designed to maintain the socioeconomic homeostasis of the capitalist city."[37] The cybernetic vision Schöffer pursued for most of his life can be thought an exercise in speculative, architectural envisioning, but equally and perhaps even more so "a massive sanitary project"[38] with the aim of seizing a tighter grip on how public space is aesthetically produced, and presumably occupied and used.

Vanel and McKee make an important statement by investigating these often-overlooked aspects of Schöffer's practice. Even if Schöffer never explicitly aligned himself with the problematic rhetoric of social hygiene, he is not exempt from critical assessment based on the company he keeps. This type of assessment is especially useful in understanding Schöffer's highly specific language: "Schöffer's lifelong association with physicians, biologists, and

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[34] See Andrea Rovescalli, "The domestication of kinetic art: The Lumino by Nicolas Schöffer," (master's thesis, Haute école d'art et de design, Geneva, 2014), http://www.earove.info/docs/the_domestication_of_kinetic_art.pdf.

[35] Nicolas Schöffer in an interview with Philippe Sers in 1971, quoted in Schnee, "Towards Dematerialization".

[36] Vanel, "Cybernetic Bordello," 111.

[37] Yates McKee, "The Public Sensorìums of Pulsa: Cybernetic Abstraction and the Biopolitics of Urban Survival," *Art Journal* 67, no. 3 (2008): 58.

[38] Vanel, "Cybernetic Bordello," 112.

psychiatrists supporting the therapeutic function of his art is as significant as his association with engineers to insure the technological viability of his art," writes Vanel. "Strongly echoing the rhetoric of the psychiatrist, Schöffer would […] characterize his art as a massive sanitary project."[39] Vanel goes on to quote Schöffer stating his pursuit of "esthetic hygiene," and it does not take too many leaps to reach the conclusion that, even if Schöffer did not design objects to be used as a form of social and biological control, he was still contextualizing his own work within the language and ideas of deeply problematic figures. Vanel picks out Jacques Ménétrier as one example, who held "toxic views" about social hygiene and the benefits of eugenics[40]; but he appears as one of a handful of writers in Schöffer's first monograph. According to Frédéric Schnee, "In later years, Schöffer tried to dispense with the possible negative connotations and misconceptions that came with this financial and commercial environment. […] He also stressed that the artist should strive to surpass the commercial aspect of production and not only be motivated by purely lucrative ends."[41] It may be the case that Schöffer's relationship to the industries of urban and technological development shifted throughout his life; yet, the desire to be apolitical does not make it so.

This type of ideation surrounding the cybernetic towers and sculptures is fundamental to understanding their complex material rhetoric. In Schöffer's unbuilt works, which are well-documented in his archives in Paris,[42] there is a clear and recognizable effort to envision new social permutations and structures and engage in corporatized technological innovation to facilitate spectacle in populated city environments. This practice does not come without a political impact. *La ville cybernétique* speaks to Schöffer's ideals as an artist, but also to a collective future. Namely, he sought to integrate his art and architecture into public spaces, so that his projects would be indistinguishable from the rest of the urban environment and form part of the backdrop for contemporary life. And for Schöffer, as is evident in buildings such as his spatiodynamic theatre, spectacle partially defined the age of human and machine interaction.

I would argue, based on Schöffer's own texts and on the materiality of his realized works, that the process of generating and documenting concepts for the implementation of cybernetics

[39] Vanel, "Cybernetic Bordello," 112.
[40] Vanel, "Cybernetic Bordello," 113.
[41] Schnee, "Towards Dematerialization".
[42] Schöffer's archive is located in Villa des Arts, Paris, upstairs in the same building as his atelier where out-of-circulation artworks are held. The atelier is open to the public on request, while access to the archives are at the discretion of Schöffer's widow, Éléonore de Lavandeyra Schöffer, who still runs his estate.

in cities exists as a crucial component of the artist's repertoire. Though *La ville cybernétique* was not published until 1969, Arnauld Pierre writes in a recent monograph that Schöffer had been in discussions with French architect and fellow Groupe Espace member Claude Parent about a 'spatiodynamic city' in the mid-1950s, "sketches for which had filled the pages of Schöffer's notebooks for over a decade."[43] Not only the cybernetic city points to the importance of the sketch in Schöffer's conceptualization of his artistic program; his numerous sketches and drawings of the unbuilt *Tour Lumière Cybernétique de Paris* (Figs. 3A & B) (as well as the few of the spatiodynamic theatre) have also featured in two recent monographs on the artist.[44] In the most recent monograph on the artist, Dominique Trudel clarifies that, in fact, "he devoted around fifteen years of his life to the venture, which was intended to be his magnum opus."[45] Schöffer once said himself that "thanks to information of all kinds, [the *Tour Lumière*] already belongs to the memorized and probably archetypalized repertory of the significant works in the domain of the plastic arts."[46] This tower and the other less recognized unbuilt towers are material evidence of his unique positioning in mid-twentieth century society, as an artist intent on playing a role in technological development and the transition to technologically-driven societies. For an artist during this period, access to such technologies was not a given. Unlike today's range of accessible tools, which make building responsive objects relatively simple, Schöffer had no option of purchasing even the most basic feedback mechanism for his projects. In fact, his sculpture was an impetus for one of the earliest exercises by Philips in homeostatic technology (or, technology capable of responding to its environment; a common and simple example would be a thermostat or temperature control system). Recognizing the significance of Schöffer's unbuilt towers is, in my view, an important step to understanding the unique materialities of his works. Here, we are forced to engage with the specific, physical difficulties that arise in making large-scale, technological interventions in public spaces. There is an inverse logic to this analysis, where asking, "How was it not built?" might reasonably lead us to "How could it built?", and prompt productive lines of questioning around how these works differ from other public art and architectural works, both in their materials and symbolic meaning.

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[43] Pierre, Trudel, and Mari, *Nicolas Schöffer*, 34.

[44] See Maude Ligier, ed. *Nicolas Schöffer* (Paris: Les Presses du réel, 2004); Arnauld Pierre, Dominique Trudel, and Pauline Mari, *Nicolas Schöffer*, ed. Arnauld Pierre (Brussels: Mercatorfonds, 2018).

[45] Pierre, Trudel, and Mari, *Nicolas Schöffer,* 196.

[46] Nicolas Schöffer, "Sonic and Visual Structures: Theory and Experiment," *Leonardo* 18, no. 2 (1985): 63.

In addition to the better-known examples of unbuilt structures that continue to shape public perception of the artist, including the *La ville cybernétique* and *Tour Lumière Cybernétique de Paris*, Schöffer had interesting burgeoning connections with cities in Canada. The potential for building a project in Montreal and possibly Toronto are shown in a sketch, newspaper article, and series of letters dated around the late 1960s and into the early 1970s. These archival documents, though limited in the details they offer (the letters, for example, only make up one half of the correspondence), allude to some of the practical hurdles Schöffer met in attempting to intervene in real, public spaces and realize his vision of cybernetic cities. In 1967, Schöffer had drawn a sketch of a cybernetic tower for Montreal, which can be seen in binders from his personal archive (Fig. 4). That same year, a newspaper article was published in Paris documenting the construction of a public tower in Montreal, which would be a collaboration between the two cities. Though Schöffer is not mentioned by name in the article, it does mention the tower's proposed height of 325 metres, which matches the archival documentation of Schöffer's Montreal tower sketch. (The newspaper article appears alongside the sketch in the archives (Figs. 5A & B) and is a document of Schöffer's potential Canadian tower according to Schöffer's widow and collaborator, Éléonore de Lavandeyra Schöffer). From these materials alone, we know that a collaboration was in the works, and given the year and the information provided in the newspaper article, it can be safely assumed as well that Schöffer's tower would have been a contribution to Expo 67 celebrations, marking Canada's Centennial and Montreal's 325th anniversary as a city. This project offers yet another evidentiary support for the idea that Schöffer was keen on participating in the production of urban spectacle, specifically through a construction of space. A few years later, Schöffer was in regular correspondence with a man named Denis Allaire, a psychologist based in Montreal. One of the most noteworthy of these letters is actually not from Schöffer, but from Maurice Archer, a Senior Vice President at Canadian National (CN), a government-owned railway company. Archer wrote to Allaire in August of 1973, noting the topic of his letter as the CN tower, whose construction began in February of that year. Archer lets Allaire know that he is available to meet with Schöffer in France at the beginning of October, and although there is no specific mention of Schöffer contributing to the design or construction of the tower, it might be understood from the topic of this correspondence that Allaire had reached out to Canadian National to reignite the possibility of a Canadian cybernetic tower.

In these documents, the distinction between Schöffer's theoretical practice and material practice becomes blurred. They, unlike a text such as *La ville cybernétique*, are not representative of some distant utopia or idealized, technologized vision of urban space. They point instead to a real interest in Schöffer's cybernetic technologies, and the possible implementations of these that went through various levels of planning and still were never constructed, due to reasons we may not know exactly, but can easily guess at: failure to pass bureaucratic inspection and acquire permissions to build; a lack of funding; ongoing maintenance and labour costs, and so on. We can also look to better documented projects for clues—for example, the numerous city players and political stakeholders involved with Schöffer's La Défense saw problems with its location and environmental impact, which became permanent roadblocks for the unbuilt project.[47] The Montreal tower was not the only mysterious unbuilt structure in Schöffer's archive, either—he also had sketches for towers in Osaka, Japan and Abu Dhabi, United Arab Emirates. His unbuilt works are ultimately the indexes of the physical ones—the first drafts, the revisions, and all of the versions therein. In Schöffer's words, "Art is a subtle navigation between the snags of redundancy and multiform information overload."[48] While the many two-dimensional iterations of Schöffer's cybernetic towers and other buildings might seem redundant, they equally quantify his practice: they are the multiform, the information overload. In order for Schöffer to imagine a non-redundant art, he inevitably crafted and re-crafted his message more than a handful of times. The texts, letters, sketches, articles, and more paper documents that have been carefully kept by Éléonore Schöffer therefore persevere as a primary site for his ideas. The slight variations among these documents are important in their own right, and with more space it would undoubtedly be useful to unpack the distinct offerings of the *La ville cybernétique* as a text and a series of images of the spatiodynamic theatre. And it is equally crucial to acknowledge the distinct materialities of these art and architectural works as they actually, or physically, existed, which is a discussion that follows in the next two sections. However, as a broad category of materials, this first stage (which is still a material stage) – the unbuilt – outlines a path for understanding Schöffer's priorities as an artist. Unlike the role of preliminary plans or sketches in other artistic fields, to shed light on the processes that led to the final product, Schöffer's built structures were just as sketchy as their unbuilt counterparts.

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[47] Pierre, Trudel, and Mari, *Nicolas Schöffer*, 200.
[48] Schöffer, "Sonic and Visual Structures," 61.

2 (v.2) Temporary

In 1954, Schöffer successfully built his first cybernetic tower in Saint Cloud Park, near Paris, for the Salon International des Travaux Publics et du Bâtiment in 1955. (Fig. 6) The tower was 50 metres in height—a steel, cage-like structure, outfitted with red, yellow, and blue plates. (In the footsteps of Piet Mondrian, Schöffer had an astute distaste for green, and usually used a primary colours scheme for his sculptural works.[49]) Being a contribution to a temporary outdoor exhibition, the *Tour Spatiodynamique, Cybernétique et Sonore* was taken down within a year of being erected, but its lack of longevity hardly interferes with its significance to any survey of Schöffer's practice. Importantly, it marked the first collaboration between the artist and Jacques Bureau—the engineer from Philips Société Anonyme that built Schöffer a unique homeostatic device for his artworks, which motivated his machines' behaviour. They called it the "electronic brain." The "electronic brain" Bureau built for Schöffer housed a rheostat, photo-electric cell system, and microphone, equipping Schöffer's machines with programmed responses to humidity and temperature, light, colour, and sound, respectively. Not all of Schöffer's machines operated with the same feedback mechanism, however, and the exact distinctions between his machines' capabilities has proven to be difficult information to find. Based on the environmental data retrieved and processed by the Saint Cloud brain, it prompted the tower to play a recording; in other instances, the recording would change, or the brain would activate a different response altogether, such as movement. Composer Pierre Henry, who would come to be another important collaborator of Schöffer's, produced the recordings for the Saint Cloud tower. His participation in the project reflected a long-held interest of Schöffer's, to "liberate music"[50] by freeing it of its start and finish, or of adhering to a set temporal measure at all. Schöffer writes in the early 1980s that "[t]he specifically programmed time of the work must intervene, participate and disappear in order to return again, in accord with the fluctuations in the programmed rhythm of the human environment."[51] At some point, for the Saint Cloud tower, the electronic brain's manipulations of environmental data factor into the artistry of the composer. A recent text from Arnauld Pierre, in fact, quotes Philips as referring to the tower as a "unique robot conductor" in their promotion of

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[49] As told to me by Éléonore de Lavandeyra Schöffer, Villa des Arts, Paris, October 2017.
[50] Schöffer, "Sonic and Visual Structures," 60.
[51] Schöffer, "Sonic and Visual Structures," 60.

the machine.[52] What, then, is the relationship between artist, machine, environment, and audience? According to a text from the 1955 exhibition, excerpted for a 1963 monograph, in composing for the tower Henry was directly manipulating the vibrations of its various metal plates: "On the basis of their vibrations, [Henry] […] has made recordings on magnetic tape which he has worked over in his own way to obtain sound material. This sound material has enabled him to compose twelve different sequences recorded on tapes."[53] This description presumably adds a second environmental element, where the environment had a part in determining the sounds themselves as well as determining the structure of their playback—with Henry acting as only an assistant to this "thinking machine."[54] The recordings were the tower's primary means of communicating—response through musical composition, which was written partially by Henry and partially by the environment, or its representation in data, or the electronic brain that acquires that data, depending on where you would locate the generative event. In this vein, the exhibition text continues: "The choice of the recordings is dictated at times by variations in the surrounding noises, at other times by those of the light or the temperature. Thus musical motifs unfamiliar to our ears are born, having at times great beauty."[55] As with all his works, Schöffer was intent on the benefits of collaboration and challenging the ultimate, capital-A artist as a singular author—and more than just desiring collaboration between humans of different disciplines (as was the case of Bureau and Henry) Schöffer used the environment as an equally important force in creating his art. Each iteration of the tower, determined by its musical response, would, hypothetically and in Schöffer's vision, differentiate it from the next. If the tower itself were not temporary, it would have nonetheless taken on multiple physical forms, all only for a brief period.

Schöffer's Saint Cloud tower marked the first successful integration of the electronic brain into one of the artist's objects. His cybernetic sculpture, *CYSP 1* (Fig. 7), which was distinct from the cybernetic towers on the basis of its scale and mobility, was built the following year in 1956. \ *CYSP 1* is now one of the most documented and discussed of Schöffer's artworks, even though it was not the first use of Bureau's technology. This may partially be due to its frequent appearances in Schöffer's collaborative performance experiments throughout the 1950s,

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[52] Pierre, Trudel, et. al, *Nicolas Schöffer*, 66.
[53] Habasque and Ménétrier, *Nicolas Schöffer*, 46.
[54] "Science: The Thinking Machine," *TIME*, January 24, 1949.
[55] Habasque and Ménétrier, *Nicolas Schöffer*, 46.

'60s, and '70s.[56] (Fig. 8) Though *CYSP 1* is not temporary in the sense of the Saint Cloud tower, which had a concrete period of time during which it was active, the sculpture's role in ephemeral events and performances such as the well-documented human and machine ballet by Maurice Béjart (also in 1956) (Fig. 9), does lend the sculpture a sense of being impermanent. It is also currently undergoing restoration, and in this respect has a place in the section of this thesis that explores the material state of being restored. But unlike Schöffer's Liège tower, which contains a history of conservation attempts and has maintained its permanent place along the Meuse river during each of those attempts, *CYSP 1* is a mobile work of art—not only mobile in the sense of being movable, but moving itself, at two different speeds and in all directions. And this is its main distinguishing feature when placed alongside the towers. The sculpture used the same environmental data – collected by photoelectric cells and microphones – that the Saint Cloud tower used, but where the latter prompted sound playback, *CYSP 1* is prompted into the motion of its parts and entire body. This would later impact the Liège tower, which maintained the sound component that defined the responsivity of the Saint Cloud tower – with a new composer – but added the capability of setting its individual parts into motion and lighting up in various colours. The functionality of *CYSP 1*, then, affords it a unique place in my argument around material stages of machines: the sculpture is simultaneously a temporary project, in the context of past performances and periods of inaction, but also holds the promise of being active again. It operates, today, in an in-between stage. To some degree, all of Schöffer's objects have passed through a temporary stage, a being in-between, if not being physically temporary in the way the Saint Cloud tower was. The point I most want to make within this self-reflexive frame of analysis is that it will soon be made irrelevant, when the restored *CYSP 1* re-enters an

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[56] Schöffer was committed to engaging audiences and encouraging spectator participation with his works; he saw his art as a total experience intended to shape environments. *CYSP 1*, referred to as a "robot dancer" by Guy Habasque, most famously appeared in a Maurice Béjart ballet that took part on the roof of Le Corbusier's Cité Radieuse in Marseille. See also sections on "Dance and sculpture" and "Cybernetics" in Habasque and Ménétrier, *Nicolas Schöffer*, 49-50. His sculpture *Le Prisme* from 1965 can be seen in Brigitte Bardot's and Serge Gainsbourg's 1968 music video for "Contact," which can be viewed online at https://www.youtube.com/watch?v=1SE_K7SSDKg. See Joseph Nechvatal, "The Visionary Modernist Experiments of Nicolas Schöffer," *Hyperallergic,* May 4, 2018, https://hyperallergic.com/440598/nicolas-schoffer-retroprospective/. In 1973, Schöffer sent his part sculpture, part automobile *SCAM* around the city of Paris—one of his many strategies for disseminating his artistic program throughout public spaces. See Susan Holden, "Nicolas Schöffer's *SCAM:* An Aesthetic Perturbation in the Urban Field," *Leonardo* 52, no. 1 (2019): 60-61 for a brief analysis of the project. Perhaps most notable of all his productions, Schöffer's multidisciplinary performance KLYDEX, shown at the Hamburg Staatsoper and featuring erotic sculptures, dancers, projection, film, and more, was what Frank Popper called "a resume" of Schöffer's audio-visual research. See *Art, Action and Participation* (London: Studio Vista, 1975): 170. KLYDEX was produced with composer Pierre Henry, who Schöffer had collaborated with previously, and American choreographer Alwin Nikolais.

environment and, having successfully completed its updates, is no longer suspended between something that did and does exist. The frame will shift, with the shifting materiality of the object. This is worth recognizing as the most significant task of the media art historian—to make room for the inevitable growth of machines.

Today, homeostatic technologies, which are designed to adapt to and often stabilize changing environments, are all around us. But in 1956, the homeostat was a burgeoning technology. It had been invented less than ten years before its use by Bureau and Schöffer by Ross Ashby, a psychiatrist who is recognized as having been at the core of cybernetics as a field. Ashby spoke at multiple Macy Conferences, aforementioned as a foundational platform for the development of cybernetics in the 1950s. In the 1952 conferences, Ashby presented the homeostat to others in the field, in two presentations: "Homeostasis" and "Mechanical Chess Player."[57] He also referred to his technology as "the closest thing to a synthetic human brain so far designed by man."[58] This parallel between technology and the human nervous system was a defining feature of Norbert Wiener's *Cybernetics*, published in 1948 (the year of Ashby's invention) and, of course, to Philips' rendition of the homeostat as well. If considering the multiple material stages that machines occupy over the course of their existence, it becomes even simpler to imagine how a machine can compare to a human body, a metaphor applied deliberately, bluntly, and insistently by Wiener, cybernetics' founder. This language is echoed in written accounts of the sculpture, such as critic Guy Habasque's, who observes that "a red light calms it and causes its movements to slow down."[59] But how much noise would one have to make to "calm" the machine? Habasque ascribes *CYSP 1* a human-named, animalistic feeling, and uses this in a descriptive capacity. As the second part of this thesis observes, the human-machine metaphor that cybernetics gave rise to is prevalent throughout art criticism about Schöffer, and it can be used in positive and negative ways. Highlighting the similarities between humans and machine could, in describing the temporariness of Schöffer's objects, better account for growth and decay—the stages in between a sketch and a realized, physical thing, and the in-between stages occupied by projects such as *CYSP 1*. That is, if we assume that machines, like humans, undergo many, temporary material stages over the course of life, sometimes simultaneously, it would make sense to build this into our analytical diagnostics. We would

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[57] Pias, *Cybernetics*, 593-619; 651-653.
[58] "Science: The Thinking Machine"
[59] Habasque and Ménétrier, *Nicolas Schöffer*, 12.

never assume that a human body functions the same today as it did ten or twenty years ago, and nor should we assume the same of machines. What initially occurred in art criticism that set out to diagnose Schöffer's works within the vocabulary of cybernetics was a metaphorical obfuscation of the functionality of the technology. Though we have a rough idea of what the electronics built into these machines can respond to, and an idea of how they behave in response, the details of these exchanges remain largely left out of the descriptions of the artworks. There is a lack of first-hand accounts of how the machines work, not just in terms of their intended functionality but their actual functionality at a specific moment. Continuing to parallel human and machine bodies, I would compare the literary treatment of Schöffer's machines to an eye doctor prescribing a patient glasses. It may be helpful to know that you need glasses, but it is the prescription, the specificity of your eyes from everyone else's eyes, and often the specificity of each organ in the pair, that matters to you as a patient. And this information is determined not only by looking at the eye, but giving it a stimulus—something to actually see, something to respond to.

In 1963, Habasque calls *CYSP 1* the world's first sculpture with "total autonomy of movement."[60] Later in the same volume, which is the first monograph written on Schöffer, he touts: "As anyone knows who has studied cybernetics a little, once the machine has been fed 'information,' it acquires real autonomy of action."[61] In 2018, we bear regular witness to technologies that truly resemble autonomous, sentient beings. Admittedly, *CYSP 1* is not that, and given its birthdate it would be an unreasonable expectation for it to come close. Nonetheless, in *CYSP 1*'s particular 1950s brand of technological autonomy, its use of the electronic brain to perform with human actors elevates the notion of feedback to not only an input and output, but an integration with environments. That is, the object not only retrieves environmental data but produces it, by taking up and moving through space, and interacting with co-inhabitants of that space. In the computational age as we experience it today, technology is still defining our environments. And we make our mark on the technologies, providing the user data that drives change in the industry. Technology is and always has been inextricably tied up with notions of ongoing growth and adaptability to surroundings. This environmental consideration – the noise one would have to make to "calm" the machine – is what is missing from so many accounts of

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[60] Habasque and Ménétrier, *Nicolas Schöffer*, 50.
[61] Habasque and Ménétrier, *Nicolas Schöffer*, 12.

Schöffer's objects, the complete evidence for which will be provided in part two of this thesis. To conclude a long preamble to a simple point: when it comes to temporary materialities, particularly temporary machinic materialities, it is clear that they are shaped by environmental circumstances. This attention to what the machine is responding to at any given moment in time, and the changing course of this responsivity, is fundamental to understanding this artist's history, and media art history as a whole.

3 (v.3) Restored

If one wants to see a cybernetic tower in the steely flesh, they head to Liège, Belgium. Schöffer built a tower on the bank of the Meuse in Parc de la Boverie, 1961, and since its initial construction the tower has been preserved, restored, and updated to continue functioning. Just slightly taller than its forebear in Saint Cloud Park, at 52 metres the original *Tour Spatiodynamique et Cybernétique de Liège* (Fig. 10) also recorded data around humidity, wind, temperature, sound, and light, but exceeded the Saint Cloud tower in its range of responses. Rather than just incorporating a recorded element that would play based on the tower's received environmental data (though it was still equipped with sound), the Liège tower also communicated in light, colour, and movement. In some ways, its capabilities might be more comparable to Schöffer's sculpture *CYSP 1* than the tower in Saint Cloud, but unlike *CYSP 1*, the *Tour Spatiodynamique et Cybernétique de Liège* is the only of Schöffer's works so far discussed that might be considered permanent. And, on the opposite side of its permanence, it does not have the range of *CYSP 1*'s mobility.

When it was first active in 1961, Schöffer's structure in Liège was paired with a visual show called *Formes et Lumières* screened on the windows of the Palais des Congrès building (Fig. 11), the tower's immediate neighbor in Parc de la Boverie. The show was produced by Pierre Arnaud, and accompanied by music by Henri Pousseur.[62] Not only considering its permanent site and its personalized spectacle in the *Formes et Lumières* show, but also its physical proximity to a public gathering place and event venue, the Liège tower successfully implemented many of the priorities that Schöffer outlined in *La ville cybernétique.* The tower has

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[62] Manon D'haenens, "The *Cybernetic Tower* by Nicolas Schöffer: the conservator's role between continuity and historicity of the production," in *Authenticity in Transition, Changing Practices in Art Making and Preservation, Proceedings of the NECCAR Conference, Glasgow December 2014*, eds. Erma Hermens and Frances Robertson, 46-53 (London: Archetype): 47. Full text provided by D'haenens to the author.

not been functional in its original form since the early 1970s, however, even though it has gone through several attempts at restoration.[63] The original electronics had been preserved physically, and yet they are referred to by the researcher Manon D'haenens as "obsolete"[64]—bringing us back to that eternal race between software and hardware, where the former consistently outruns the latter. This phenomenon, of course, is also a product of the capitalist, consumerist *Zeitgeist* that drives technological innovation and seeks to constantly replace old machines with newer, shinier, and ultimately more expensive ones. Considered in the frame of art history, D'haenens' analysis of Schöffer's tower is unique, in that, thinking from the perspective of conservators, they are able to incorporate the material evolution of the tower into its central meaning and significance. Quoting Schöffer, who himself foregrounded the concept and "sociocultural impact" of his cybernetic works rather than their materiality, D'haenens argues: "We are confronted with the fact that the best way to respect the artist's intent is to change and substitute it – not attempt to maintain it in its historical condition. Nicolas Schöffer made a continuous artwork that needs to be continually updated: an open-artwork concept."[65] As this thesis has argued up to this point, the uniqueness of Schöffer's art was precisely its evasiveness, how difficult it was and is to capture in any singular form. I share an opinion with D'haenens here, that in order to stay true to the work, one has to open up, so to speak, to the changes it undergoes through machinic updates. But what piques my curiosity even more about the Liège tower is the ways in which its idea and sociocultural impact, to borrow Schöffer's language,[66] are intertwined with its material state. I would argue that regardless of their shared relationship to Schöffer's artistic program, there is no single analysis that can be applied across the cybernetic tower's different versions, and subsequently, I believe that any historical or critical approach to the tower might at the very least consider a difference in approach across its different versions. To conclude this first part of the thesis, leading into a more precise critique of the historiographies of Schöffer's works and their difficulty to account for the materialities they inhabit, I will point specifically to the material changes undergone by the Liège tower and why its original version cannot be used as a substitute, symbol, or even metaphor for its most recent iteration.

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[63] D'haenens, "*Cybernetic Tower*," 47.
[64] D'haenens, "*Cybernetic Tower*," 47.
[65] D'haenens, "*Cybernetic Tower*," 48.
[66] Nicolas Schöffer quoted in D'haenens, "*Cybernetic Tower*," 48: "What particularly interests me of this tower, is that, during a century, it will be permanently modifiable. *It is not a finished work, it is an open-artwork.* As new ways will be discovered, they will replace those that already exist. What matters is the idea, and its sociocultural impact."

According to another text by D'haenens, the decision to deviate from the Liège tower's original functionality would have aligned with the artist's "desire to actualize his works with new technologies."[67] Where Schöffer's unbuilt and temporary works existed, and continue to exist, as only potentialities, designed and built for the concept of growth but without necessarily attesting to this priority physically, the Liège tower has permanently withstood generations of technological change. And its current state, as of the 2016 restoration (Figs. 12A & B), is truly exemplary of an artwork that has "actualized" in an entirely different technological period than it was borne into. According to D'haenens, "Keeping the artwork in action for the next generations by its (re)actualisation [sic] is an act of transmission."[68] The tower is still equipped to move, and flash its lights in various colours. It no longer emits an audio track, but in some ways the directness of feedback to its audience has been vastly improved. The tower's colours and movements are not determined by environmental data, as it was in 1961 at the time of its construction. It responds, instead, to the social media platform Twitter.[69] It can not really have a conversation with you; it only responds to direct colour prompts. For example, you may write, simply "Blue"; or, compose a casual request, such as "Yellow please!" It will flash in the colour you request, and tweet back with a song lyric that includes that colour, such as "We all live in a yellow submarine." This Beatles line shows up multiple times on their short thread. In my experience with the work, it responded up to "I just loved yellow so much, let's do it again," but I did not test the outer limits of its comprehension by strategically placing colour cues in more complicated texts. I find assessing this updated, twenty-first century form of the tower surprisingly intimidating, particularly in comparison with its former version. On the one hand, we might see this updated form of the work gimmicky, designed to entrap tourists (which it almost certainly is, based on an initial read of the tower's personal website, found here: www.tourcybernetiquedeliege.be). Its repetition of song lyrics could be interpreted as a snag in its communication as well, a flagrant redundancy that gives away the machine's limits. On the other hand, we only know limited information about the tower's first version, particularly in

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[67] Manon D'haenens, Muriel Verbeeck, and David Strivay, "The Collection of Nicolas Schöffer: From the Artist's Studio to the Museum," in *Keep it Moving? Conserving Kinetic Art*, eds. Rachel Rivenc and Reinhard Bek (Los Angeles: Getty Conservation Institute, 2016), http://www.getty.edu/publications/keepitmoving/theoretical-issues/14-dhaenens/.

[68] D'haenens, *"Cybernetic Tower,"* 51.

[69] You can find the *Tour Spatiodynamique et Cybernétique de Liège* on Twitter at the handle @CyberTower, https://twitter.com/cybertower?lang=en. Its profile reads: "Born 1961 from artist Nicolas Schöffer. I am aware of my environment and react to it. Send me a tweet containing red, yellow, green or blue and I'll flash!"

terms of the sensitivity of its responses and its real-time functionality, and may not have the experience to say that this new version is a lesser version or an improved version of that responsivity. (And the instinct to put gimmicks at a sharp contrast to successful art and architecture also needs to be questioned.) The Liège tower in 2018 is only a *different* version than its original, and it requires an analysis that accounts for the distinct sociality of Twitter as a platform, and understands the obvious as well as the nuanced differences in its restoration.

The word "actualize" is a curious one, especially when applied to an art object, and it caught my attention in the context of Schöffer's historiography. The word "actualization" has strong ties to psychology and self-help rhetoric. The journey toward self-actualization forms the basis for more than one psychological camp, including Abraham Maslow's hierarchy of needs from the 1940s and the "Human Potential Movement" of the 1960s and '70s. Though the meaning of "actualize" in fact has no inherent or defining relationship to psychology, it is rare to hear it used for anything other than human beings and behaviours. Nonetheless, it was used by conservator and researcher D'haenens with respect to Schöffer's art on more than one occasion, and specifically the decision on behalf of the conservator to dramatically change the work's functionality with its technology update—justifying this change on the basis of actualization, a becoming in the twenty-first century for this twentieth-century artwork. Again, the human-machine metaphor asserts itself, raising the question as to what actualization in machines might mean. Surely, for Schöffer's cybernetic art, 'actualization' is not the evolution of a self, much less of a better self—though I admit Schöffer was not far off from the notion of machine learning and artificial intelligence, and I do think the phrase 'new and improved' has relevance for human beings and technological things alike. The word's present participle form, "actualizing," is used again by French scholar Maude Ligier in a 2004 monograph about Schöffer. In clarifying language, Ligier writes:

> With an artist like Nicolas Schöffer we go beyond imaginary realities: we are on the level of potential virtualities that are actualizing. And this thanks to the introduction of a fourth dimension, that of time, that of the rhythms of life and even more that of cybernetics, which goes beyond the era of mechanical rationality and the era of organic civilization, to reach the era of communication.[70]

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[70] Ligier, *Nicolas Schöffer*, 130. All translations of this work are my own. In this case, it may be noted that the word actualisé in French does not carry all of the same significations as the English word actualize. However, the use of the English form in d'Haenens does support the interpretation presented here.

Potential virtualities that are actualizing. Crucially, Ligier posits "potential virtualities" as oppositional to "imaginary realities," a slight and nuanced distinction that becomes perhaps clearer in the computational age, where the realm of the virtual becomes decisively more real, or material, than the realm of imagination. Physically, users engage in personal and collective virtualities every day online—versus imaginations, that arguably become virtual space at the moment they are rendered in some communicative form, taken from a personal and ideational stage to a space that can be shared. Ligier points to communication in this excerpt, as the logical progression from "mechanical rationality" and "organic civilization" (though we might complicate this notion altogether, given what the rhetoric of civilization often points to, i.e. colonialism). Schöffer's cybernetic projects do possess all manner of "potential virtualities," to the extent that each is programmed to exist in multiple, mutable, material forms. Even Schöffer's unbuilt works could be argued to exceed the realm of the imagination, to the extent they so often harboured the potential of one day being built – as was the case with the Montreal tower, a project that evolved to the point of being publicly announced – and usually existed in different material iterations, though obviously not their intended ones.

Ligier assists a better understanding of actualization in machines by suggesting that its basic defining factors are time and communication, rather than evolution and subsequent betterment (basically time in a set, unified direction). Instead, time is introduced not necessarily as a measure, but a dimension in which change is able to occur, freed from the promise of improvement. That is, time is a condition of actualization, but the evaluation of this process shifts from one where coming-of-age and improvement are the ultimate and only goals. Or, perhaps the qualities that constitute improvement just shift. Even more relevant to the Liège tower, time is bound with communication in Ligier's essay (again, here I interpret time as a condition for communication to occur, and not its measure or rule). Putting aside the modern aesthetic values that still to a certain extent govern art history and criticism – particularly the elevation of art through temporal periods, each one building on the next, each one building to the artist's next genius endeavour, which is itself defined solely on the basis of a break with the past and the fallacy of originality and newness – Schöffer's tower in Liège actualizes vis-à-vis its communicability. Specifically, it actualizes through the timeliness of its communicability, referring both to the promptness of its retort and the contemporaneity of its platform. Somewhat

ironically, good, useful technology is assessed on similar bases as modern art, especially the state of newness, having been updated to reflect the status quo. The Liège tower is actualized in all of these ways: the new and improved, the original, the communicative, the timely. However, it is simultaneously stripped of its psychotherapeutic associations, the romance of human evolution and civilization and that of the artistic genius. Instead, it is laid bare in its corporatized state. On the promise of actualization, an entire self-help industry is built; with the promise of being 'new and improved,' an entire technological industry is built, pushing upgrades to each and every user in the hopes they render their current machines useless. Schöffer's only permanent tower has survived on this truth alone: that to avoid inevitable uselessness, machines must actualize, thus making time their only condition of existence and communication their priority. Gone are the days of actualization as a romantic myth of improvement: in the technological era, actualization is being – and staying – in use.

II Reconciling Media and Matter on the Margins

Schöffer worked in a range of media, and not all of it consistent with art's mid-century norms. Narrowing the scope to his milestone cybernetic endeavours as I have done here hardly makes it any easier to summarize the multiplicity of his projects and structures—each occurring in multiple stages, or versions, and within each of those versions having the capability to adapt to environments and quite literally change their tune. In the introduction, I named the framework for this research as materialist historiography: a historiography that leads from materiality, assessing objects and their histories on the basis of their physical attributes and capabilities, and asking questions directly related to materials in order to reach an object's social, cultural, and ideological impact. Part one of this thesis therefore set out to highlight some of the unique physical attributes of Nicolas Schöffer's cybernetic art, and its need for a host of supporters in order to be built and maintained, in order to better analyze the language used by critics and historians to make sense of these materialities. Text analysis is the task taken up in greater detail here in the second part.

Until the 2000s, after Schöffer's death and well after the first cybernetic tower was built in 1955, there were few art-historical endeavours to understand the significance of his work to current trends in media art. As conversations about human and machine interaction have come to define contemporary thought, not to mention contemporary art, interest in Schöffer's practice has

intensified in the past two decades: Maude Ligier wrote a monograph on the artist (published by Les Presses du Réel in 2004), followed by one by the Fondation Vasarely published alongside a solo exhibition of the artist, also in 2004. In 2018, a second monograph was published by the Lille Metropole Musée d'Art Moderne, in conjunction with their hosting the artist's first solo retrospective.[71] In between the releases of these two larger, focused volumes, articles, graduate theses, and other publications offering either analysis or mention of Schöffer appeared more consistently than they had since the 1970s.[72] It follows that cybernetics would share this period of revival, with the publication of books such as Andrew Pickering's *The Cybernetic Brain: Sketches of Another Future* in 2010; the publication of the Macy Conferences transcripts in 2016; and architect Liss C. Werner's edited anthology *Cybernetics: State of the Art* in 2017. Though Schöffer's art interests me as a series of objects, it is art history's moody relationship to it that I find especially intriguing, and I wonder about the lessons to be learned from further mining the written histories of Schöffer's cybernetics. Specifically, the sparse discussion of threshold and limit in Schöffer's historiography piques a useful curiosity about what it means to write machines, where the act of writing itself can be interpreted as the inscription of a boundary that may mimic, or not, its material limits. I therefore hope to address two primary questions before this thesis reaches its conclusion: What do the many materialities of cybernetic art have to teach us about writing? And, how does writing become material, impacting the lives of these objects in turn?

By continuing my analysis of Schöffer's cybernetic art as not only objects, but objects *of study*, it is my intention to prove that responsive machines require a distinct set of questions and concerns to be understood and documented by historians. I first re-situate the material stages of Schöffer's objects in a historical frame, considering how the occurrence of disruption has been generative for both Schöffer's art and art history. Following some speculation around Schöffer's

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[71] See Ligier, *Nicolas Schöffer*; Pierre, Trudel, and Mari, *Nicolas Schöffer.*

[72] For additional scholarship around Schöffer's works see Dominique Trudel, "L'abandon du projet de construction de la Tour Lumière Cybernétique de la Défense," *Le temps des médias* 1, no. 28 (2017): 235-250; Rovescalli, "The Domestication of Kinetic Art," 2014; Carlotta Darò, "Nicolas Schöffer and the Cybernetic City," *AA Files* 69 (2014): 3-11; Larry Busbea, "Kineticism-Spectacle-Environment," *October* 144 (2013): 92-114; Hervé Vanel, "Visual Muzak and the Regulation of the Senses. Notes on Nicolas Schöffer," in *Audio • Visual: On Visual Music and Related Media*, ed. Cornelia Lund and Holger Lund, 58-75 (Stuttgart: Arnoldsche Verlagsanstalt, 2009); Maria Fernández, ""Detached from HiStory: Jasia Reichardt and Cybernetic Serendipity," *Art Journal* (Fall 2008): 6-23; Yates McKee, "The Public Sensoriums of Pulsa: Cybernetic Abstraction and the Biopolitics of Urban Survival," *Art Journal* 67, no. 3 (2008): 58; Larry Busbea, *Topologies: The Urban Utopia in France, 1960-1970* (Cambridge: MIT Press, 2007).

art's history, I look more closely at how art critics and historians writing contemporaneously with the production of Schöffer's cybernetic art struggled to understand its specificity not only in the context of other artworks but machines in general—and sometimes seemingly overlooked its specificity on purpose, to support a pre-existing art-historical narrative or category. Curiously, Schöffer's art provoked mid-century attention on the basis of its novelty, but not specifically its functionality. It mattered that Schöffer was making responsive, environmental works, but it seemingly mattered less that the effectiveness and bandwidth of this responsivity be measured. It is not my intention to lay blame on these individual writers, who, for the most part, were not writing exclusively about art, science, and technology, and did not necessarily see themselves experts in the subject. The technology was also unfamiliar to most at the time, and would have required more than an art historian's intuition or common sense for its capacities to be determined. Furthermore, I appreciate the value of contextualizing a work of art and understanding how its trajectory compares with others through literature that reflects the period. Rather than criticizing these writers and texts, I decided to do a closer reading in the hopes I may be able learn some useful lessons from this process, and, through using my position as a reader rather than a writer or researcher, highlight some of the missing pieces. Then, to close, I consider how contemporary approaches to media art history still reflect some of the same gaps, or have recovered from them. Optimistically framed as a troubleshoot, I use the closing section of this second part of the thesis to ask, *why*? Why has media art history, and especially the history of responsive or interactive art, had such an odd and scattered progression? Why is there no unified consensus on an approach, or even a suite of approaches, for media art historians to take? Why have so few people asked these questions that I ask now, and why have even fewer posited possible answers? Lastly: How does cybernetics, the field in which media arts originated, offer some sort of solution? This last question demands an entirely separate analysis, but is explored in broad strokes in the conclusion.

1 Engineering Disruption

'Rupture' is one of the central themes of Schöffer's practice, remarks Maude Ligier in a 2004 monograph about the artist. She identifies rupture as a reoccurring event in the artist's biographical timeline, describing his stark transitions from painting to sculpture to cybernetic

sculpture.[73] Then, in the cybernetic sculptures, rupture takes on a more material significance. For Ligier, Schöffer's first cybernetic tower in 1955 represented "the use and staging of rupture, rupture putting an end to a phenomenon of wear and tear to give rise to a new process of life."[74] Rupture in the context of cybernetics is not a breaking point that puts an object out of use, but a micro-process of decay and growth. In translating her text, then, we might think of rupture both as a break, and also as a disruption—the latter signifying malleability, an interference but also an implied or intended continuation. In this way, Schöffer's cybernetic artworks are early models for twenty-first century machines, with their many lives and lifespans.

The notion of rupture has a key place in art history, too. Western, modern art history insinuates, with every passing trend or movement, a rupture—and this is precisely how Ligier invokes rupture in the context of Schöffer's chronology as an artist. The artist's personal mandate also reflects this modern fascination with isolated temporal breaks and leaving the past behind to form an improved present. The artist is quoted as saying that he pursues neither change nor renovation (or reconditioning), but to begin from nothing.[75] This fantasy of a blank slate, consisting of nothing to change or revise, but only empty space to build, is quintessentially modernist. However, as Ligier attempts to get at in her essay "La rupture dans l'oeuvre de Nicolas Schöffer," Schöffer's fantasy of the blank slate is a nuanced claim, similarly to the nuance of improvement discussed in part one of this thesis. That is, although Schöffer seeks to build anew, he nonetheless builds objects that are intentionally aligned with growth through adaptability. Similarly to the ways I see art history's idea of improvement evolving past the subjective views of the tastemaker in Schöffer's practice, where improvement collapses into retained functionality through regular maintenance, I also see rupture evolving past its reductive use along a line of chronological singularity. In fact, Ligier argues that in Schöffer's art, "rupture" is synonymous with a "field of possibilities,"[76] a multiplicity of spatial permutations and orientations. Rupture, here, is plural not singular; it refers to something active, living, occurring within the object and not simply represented by the object. And in stating his desire to create something from nothing, perhaps Schöffer is not speaking about his mark on the past,

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[73] Ligier, *Nicolas Schöffer*, 28-29.
[74] Ligier, *Nicolas Schöffer*, 29.
[75] Ligier, *Nicolas Schöffer*, 28.
[76] Ligier, *Nicolas Schöffer*, 29.

perceived as an empty space in which to act: instead, he is himself architecting the empty space to be acted on—namely by seeking to create not only objects, but the conditions for creation.[77]

For all basic cybernetic machines, disruption is the complement to control; it describes the situation to which the machine, and its internal homeostatic device, is programmed to respond in an attempt to establish equilibrium. Or, put another way, it is the thing-to-be-controlled. At least, this is true in the context of "first wave" cybernetics from 1945 to 1960, defined by feminist technoscience theorist Katherine Hayles as "the foundational stage during which cybernetics would be forged as an interdisciplinary framework that would allow humans, animals, and machines to be constituted through the common denominators of feedback loops, signal transmission, and goal-seeking behaviour."[78] Putting aside Hayles' definition of cybernetics as an interdisciplinary framework, which will be my focus in the following sections, I first want to highlight how Schöffer's practice related to the motions of cybernetic history, and perhaps more so than to the motions of art history. Schöffer began thinking about cybernetics in its earliest stages of development, and several of his works were produced toward the first wave of cybernetics defined by Hayles' article (with the second, led by Austrian Heinz von Foerster, purporting the view that "the observer of systems can himself be constituted as a system to be observed,"[79] and the third being borne of virtual realities). Schöffer's definition of cybernetics, first printed in *Le nouvel esprit artistique* in 1970 and subsequently repeated in numerous texts, is also consistent with first-order cybernetics, incorporating key words including efficiency, government, control, and regulation:

> Cybernetics is the realization of the vital process that keeps all phenomena in balance. It is the science of efficiency and of government through the organized control of all information, including those concerning disturbances of all kinds, with a view to their treatment in order to achieve the optimal regulation of any organic, physical or aesthetic phenomenon. It results in a fluid permanence, in a flexible equilibrium, where each appearance of a tendency to periodicity or

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[77] In the original French, "L'artiste ne créer plus une oeuvre ou plusieurs oeuvres, mais il créer la création." See Schöffer, *Le nouvel esprit artistique*, 46.

[78] Hayles, "Boundary Disputes," 441.

[79] Hayles, "Boundary Disputes," 442.

stagnation causes the intervention of adequate disturbances to preserve
the openness and randomness of any evolutionary process.[80]

However, Schöffer was not directly introduced to cybernetics by Wiener's first book, which did not get translated to French until 2014.[81] He familiarized himself with Wiener through the scientist's second volume, *The Human Use of Human Beings*, which was published in 1950 and translated to French in 1952.[82] (This might explain Schöffer's emphasis on the regulatory or governmental uses of cybernetics in his own definition.) Schöffer contacted Wiener directly to demonstrate his interest, but the scientist's response would indicate that he did not relate to Schöffer's artistic interpretations of the new science, reading: "I am afraid your interests are more remote from mine than you seem to believe. I do not see any clear way to grant you an interview."[83] Despite the fact Schöffer was theorizing his new art in the context of the first two decades of cybernetic research, there are significant characteristics of the second that better relate to the artist's interest in the open, always-evolving artwork. The second wave of cybernetics, further described by Hayles, was interested in organisms that are "not only self-organizing, but self-making."[84] Second-order cyberneticians also included figures such as Gordon Pask, who actively produced art and even participated in major cybernetic art exhibitions alongside Schöffer.[85]

It can be inferred from scholarly writing about Schöffer and the artist's own writing that one of the key differences between the ways he and first-wave cybernetic thinkers conceived of machines has to do with the role of disruption in the computational system or program.

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[80] This translation is adapted from the English translation provided in Schöffer's "Sonic and Visual Structures," 68: "Cybernetics is the awareness of the process that keeps phenomena in balance. It is the science of efficiency and government by the organized control of all information, including the data that concern perturbations of every kind. These perturbations are processed so as to achieve the optimum regulation of every organic, physical or aesthetic phenomenon. The result is therefore a fluid permanence in flexible balance. In this balance every appearance of a tendency toward periodicity or stagnation triggers the intervention of the perturbations needed to maintain the openness and the contingent character of any evolving process." For original version in French see Schöffer, *Le nouvel esprit artistique*.

[81] The first French translation of *Cybernetics* was published in 2014: *La Cybernétique: Information et régulation dans le vivant et la machine*, trans. Ronan Le Roux, Robert Vallée and Nicole Vallée-Lévi (Paris: Seuil, 2014). For an overview of how cybernetics reached a French audience, see Christopher Johnson, "'French' Cybernetics," *French Studies* 69, no. 1 (2015): 60-78.

[82] Pierre, Trudel, and Mari, *Nicolas Schöffer*, 136. See: Norbert Wiener, *Cybernétique et société: L'usage humain des êtres humains* (Paris: Deux-Rives, 1952). This book was subsequently revised and republished in French by 10/18 Union Générale d'Éditions in 1962 and in 1971, and again in 2014 by Éditions du Seuil.

[83] Quoted in Darò, "Cybernetic City," 5.

[84] Hayles, "Boundary Disputes," 442.

[85] Pask and Schöffer both showed works in *Cybernetic Serendipity* in 1968. See Jasia Reichardt, *Cybernetic Serendipity: The Computer and the Arts* (London and New York: Studio International, 1968).

Importantly, they both saw disruption as crucial to understanding machines—but Schöffer's emphasis on adaptability reflects, in many ways, a willingness to work with/in disruption rather than attempting to mitigate or eradicate it. In fact, his definition of cybernetics states that disturbance should be forcefully generated and introduced to the machine should its circumstances become too stagnant. Frank Popper, the established British art historian, further reinforces this aspect of Schöffer's works in his 1975 book *Art, Action and Participation*: "If the influence of humidity, temperature, light, wind, and sound produces an undesirable uniformity, interference elements will come into play and cause the tower to function in a more dynamic way," he writes. "The phenomenon of perturbation is the main source for achieving true equilibrium."[86] These works should be understood, then, not in terms of equilibrium but a shift in equilibrium, or a generative change. Schöffer's 1978 book, *Perturbation et chronocratie* (or *Disturbance and Chronocracy*), further speculates about what cybernetic consciousness looks like, and as the title indicates, disturbance to the program (the structure of the cybernetic consciousness) is somewhat ironically theorized as one its constants. The book is, by any account, a heady undertaking for its writer and reader both—but it does offer some insight into Schöffer's relationship to disruption in his works through a theory of the disturbance. According to Schöffer, "The disturbance is an energetic stimulus secreted by any evolutionary process whose program reaches a threshold of redundancy, saturation, periodicity or stagnation. Without disturbance the process must regress or disappear."[87] For Schöffer, then, the attempt to control the disturbance would be futile, and misguided. "Only the disturbance," he concludes, "[…] emerges as permanence."[88] The health of the program relies on the disturbance to prompt its growth and adaptation to new circumstances. Schöffer's reference to an "evolutionary process," as well, brings us back to the co-constituting relationships between humans/animals and machines that second-wave cybernetics brought to the fore. The unpredictability of organic forms of life are made a more significant factor. Second order cybernetics is therefore less in service of a political mandate, or an effort to exert control over a population, and unlike the originary cybernetic scientists, von Foerster and his contemporaries Humberto Maturana and Francisco Varela were pursuing a more networked understanding of how environments, humans, and technologies communicate. Compared with the so-called "goal-seeking behaviour" of early

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[86] Popper, *Action and Participation*, 77.
[87] Nicolas Schöffer, *Perturbation et chronocratie* (Paris: Denöel/Gonthier, 1978), 26.
[88] Schöffer, *Perturbation,* 45.

cybernetic technologies, which is behaviour motivated by a control mechanism, Schöffer's objects better situate themselves beside and beyond the unknown. He, in a pursuit arguably similar to that of the second-order cyberneticians, sought to open up the communicative field, not make it tighter and narrower. In *Perturbation et chronocratie*, he attempts to reconcile mind and matter in this expansive communicative field, which is composed of a chain of actions and reactions all centred on the disturbance. How do the spiritual and the material come together in cybernetic consciousness?

> All this to arrive at the preponderance of the mind or matter, without any logical final other than the more or less intense and complex animation of a trajectory whose end-of-course is nothingness. The temporary justification of life in general and of the participants in particular is not related to long-term goals but to the realization of the project, that is to say the construction of its own structures planned for inside or outside other surrounding structures.[89]

The cybernetic consciousness, which I understand to be a different way of framing a responsive machine, is therefore not, in Schöffer's view, an attempt to simulate the human mind alone (even though the name of his machines' "electronic brain" might lead us to think otherwise). Cybernetic consciousness is made manifest in the midst of a long-waged battle between mind and matter, its boundaries as messy as life itself, which "seems to give itself a structure as if to justify itself provisionally, but in the end the spiritual and the material only make null matches."[90] When Schöffer says he wants to begin from nothing, I would speculate that he refers to the empty spaces formed in the act of becoming, when mind and matter become entangled with environment—and in Schöffer's practice, the shifting roles of humans, machines, and environmental actors are prompted largely by disturbances. This is true in a broad and abstract sense, if thinking in terms of the social and political disturbances that prevented many of his projects from being built. It is also true in a more intimate, material sense, in that his machines were built to not only respond to but generate disturbance, though this intention did not necessarily come to full fruition. The disruptive capacity of Schöffer's art therefore lies in its electronically-propelled will to act, beyond the requirement of human intervention and more importantly, beyond the requirement of regulation and control. In its behaviour, it challenges

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[89] Schöffer, *Perturbation*, 45-6.
[90] Schöffer, *Perturbation*, 46.

several boundary lines: that between subject and object, object and environment, object and time. Could it be that its will to act is also the thing that characterizes its will to survive, even if survival comes in the form of a colourful iron and steel Twitter hub?

Schöffer's interpretation of cybernetics, as expressed through his object-based and written works, recalls Andrew Pickering's observation that cybernetics "assumes an *ontology of unknowability*, as one might call it, and tries to address the problematic of getting along performatively with systems that can always surprise us."[91] The surprise has poetic resonance with the disturbance, affording it a warm welcome perhaps otherwise missing in the literature. Pickering has pointed out, as well, that although second-order cybernetics is known for the more integrated view that the observer of the system is, themselves, a part of the system, its focus on epistemology might be better re-thought in terms of ontology.[92] The first-wave cybernetician's attempt at apprehending the object through observation of the system was replaced in second-wave cybernetics by an interest in the production of knowledge. As a consequence, second-wave cybernetician's emphasis on their own self-making as the observer in the system overlooks the material "mangling"[93] of both the object and its observer with their environment—what Pickering calls the "performative materiality of the field."[94] In each of their unbuilt, temporary, and restored material stages, Schöffer's cybernetic towers and sculptures do not always meet a standard of performance as technological objects, but they are nonetheless thoroughly imbricated with the other actors and performances that constitute the social field. Their performance therefore exceeds a question of efficiency, or even usability. If the external or environmental disturbance is what the first order cybernetic object seeks to control, Schöffer's objects are absorbed into the disturbance and deployed as amplifiers, acting in direct response but not usually with the aim of reversing change. (For example, a shift in temperature does not motivate correction to or restoration of a desirable temperature, but a purely aesthetic program signifying the shift itself.)

In a talk at Concordia University in February 2019, Wendy Hui Kyong Chun, author of *Updating to Remain the Same: Habitual New Media*, encouraged media scholars to develop

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[91] Pickering, *Cybernetic Brain*, 23.
[92] Pickering, *Cybernetic Brain*, 26.
[93] Pickering, *Cybernetic Brain*, 18. See also Andrew Pickering, *The Mangle of Practice: Time, Agency, and Science* (Chicago: University of Chicago Press, 1995).
[94] Pickering, *Cybernetic Brain*, 26.

more generous and generative ways of understanding imperfection.[95] I could not help but think of the often faulty performances of Schöffer's cybernetic art, and all of the ways they have been ignored and erased in descriptions of the work. There is so much to say about Schöffer's artworks beyond their role as aesthetically functional objects. In fact, their aesthetic dysfunction might be their greatest and longest-lasting legacy. Periods of optimal functionality make up a notably small percentage of their total lifespans. For the critics and historians who took Schöffer up as a subject, and his works as objects, the task of describing the work is essentially a task of tracing the history of the work through disturbance and, sometimes, failure. Considering the role of disruption, disturbance, and perturbation in Schöffer's art history, his objects are given better definition through a philosophy of event and material unfoldings than through regulation and control. They are ontological explorations of unknowability, in line with much later cybernetic experiments by the more liberal British cyberneticians, such as Gordon Pask and Stafford Beer.[96] Popper even went on in *Art, Action and Participation* to write, in comparison to the impact of the computer as a tool for artists, "the implications of cybernetics with regard to creativity are even more far-reaching."[97] Considering the ways Schöffer's work has been written about, particularly in its earliest transcribed histories, it is easy to miss the nuanced significance of rupture. To tease out this nuance, of course, requires re-thinking the way we capture artwork in language. Rather than centering the object or centering ourselves (as in first-wave and second-wave cybernetics respectively), Schöffer's machines ask us to de-center both in favour of a networked, integrated approach, where environments, objects, humans, and other-than-human beings act, together.[98] Semi-permeable, mutable, the shifting boundary line of Schöffer's art proved far too slippery for many in the business of words. This type of failure is what I dedicate myself to in the following

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[95] Chun invoked Grace Hopper as an example. A key figure in the history of women and computation for her early innovations in programming, Hopper is a rich subject of study for those of us working adjacent to science and technology—but Chun noted that Hopper did not identify with the feminist movement and even denounced it. This complication in Hopper's feminist hero narrative led to a question of how we can write histories that better account and allow for blemishes and failures. (Summary based on notes taken while in attendance at public presentation. Wendy Hui Kyong Chun, "My Mother Was a Keypunch Operator" (lecture, Concordia University, Montreal, QC, February 5, 2019)).

[96] Pickering, *Cybernetic Brain*, 223.

[97] Popper, *Action and Participation*, 223.

[98] This relational way of understanding the world, which de-centers human beings and puts emphasis on networked ecologies, has deep roots outside Europe and the West. See references provided in note 10. See also Jason Edward Lewis, Noelani Arista, Archer Pechawis, and Suzanne Kite, "Making Kin With Machines," *Journal of Design and Science*, July 16, 2018, https://jods.mitpress.mit.edu/pub/lewis-arista-pechawis-kite.

section: the failures of history, chronology, and the view that rupture is nothing more than proof of a before and after.

2 Writing the New Nonhuman

As Hayles explains in her article, "Boundary Disputes: Homeostasis, Reflexivity, and the Foundations of Cybernetics," though cybernetics might have begun with an impulse to control or regulate, its complex histories defy this kind of easy summary. While laying out cybernetics' three main "waves," she observes that "the changes appear to be much more like what archaeological anthropologists find when they study material culture: instead of a sudden break, change came about through overlapping patterns of innovation and replication."[99] Schöffer's objects, caught in their own patterns of innovation and replication, illustrate the very structure of cybernetic histories. It is almost as if the histories of cybernetics and the histories of cybernetic objects have inadvertently taken on the qualities of their robotic subjects. Observing the qualities of a history with hindsight and writing that history are two different things, however. At the time Schöffer built his first tower, modern criticism was at its peak. Infamous modernist critic Clement Greenberg wrote his seminal essay, "Avant-Garde and Kitsch," in 1939, and after developing those initial ideas in the decades that followed (concurrently with the rise of abstraction in the United States), published his arguably most iconic essay, "Modernist Painting," in 1961. So, although the development of cybernetics is a cited influence on Schöffer's theory of spatiodynamism, it was being funnelled through the language of modern art criticism. Biologist Jacques Ménétrier – identified by Hervé Vanel as one of Schöffer's "long-time acquaintances" whose own scientific work, it should be noted, was deeply disturbing[100] – wrote that in encountering Schöffer's works, "one felt that one had at last discovered pure abstraction."[101] We can speculate this type of association as one possible reason that the literature assessing Schöffer's work from within its own period takes various paths relevant to other modern art movements: the spiritual nature of art, as a tool to elevate humankind; the rapid proliferation of categories and schools or groups of artists to account for art's new forms; the struggle to reconcile art's organic, vitalist, and humanist past with its industrial future. There is

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[99] Hayles, "Boundary Disputes," 443.
[100] Ménétrier was a "promoter of eugenics," articulated through his own theories on "'social hygiene' (including biological control)." See Vanel, "Cybernetic Bordello," 113.
[101] Habasque and Ménétrier, *Nicolas Schöffer*, 90.

writing about Schöffer's art that brings us down each of these paths, and here I will try to tease out how the combined lexicon constructed from these readings, the linguistic frame for Schöffer practice, foreshadows current methods for talking about technology.

Modern writing about art and modern writing about technology share in a search for the spiritual in objects. The way this search is framed varies—sometimes it is driven by a rhetoric of transcendence and greater being, and sometimes it has to do with the ways objects and artists make magic. Curiously, in other cases the religious overtones of spirituality enter into the same descriptions as the suggestion of magic or fantasy. For example, in his introduction to the first monograph published on Schöffer, in 1963, Jean Cassou refers to the artist as a "sorcerer […] who has made a pact, not with the devil, but with the spirits of the air, of light."[102] Later, in the same volume, Jacques Ménétrier goes on describing his experience of Schöffer's art in terms of entrancement: "Completely under the spell, I no longer knew what I heard or what I saw, and for half an hour I penetrated into a Universe in which sensation no longer belonged specifically to the ear or to the eye, but was transcended beyond fundamental distinctions."[103] The idea that Schöffer's art seeks "to elevate man and to liberate him"[104] was reflected on by Maude Ligier in her much more recent monograph, where she also makes note of how Schöffer's art was perceived in beyond-human terms—as a vehicle for the transcendence of the spirit through the magic of technology. This, precisely, is Clarke's third law: Any sufficiently advanced technology is indistinguishable from magic.[105] Ligier points to Schöffer's departure from painting as the catalyst for this shift in his image as an artist, from your average modernist to the modern magician. "This initial rupture, at the age of thirty-six," she writes, "opened up to him all sorts of unprecedented perspectives which he endeavours to explore with a genius particular to himself, to the point of appearing very quickly in the eyes of the critics of his time, like the 'sorcerer's apprentice,' 'the Leonardo da Vinci of the twenty-first century,' 'the magician of light.'"[106] Even Schöffer felt he was getting at something beyond himself through his art, writing in 1966 that when attention is paid by artists and thinkers to the structure of time, "this notion of a kind of God will appear clearly as a non-temporal and permanent phenomenon, active and

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[102] Habasque and Ménétrier, *Nicolas Schöffer*, 9.
[103] Habasque and Ménétrier, *Nicolas Schöffer*, 91.
[104] Ligier, *Nicolas Schöffer*, 28.
[105] Arthur C. Clarke was a British science fiction author. He wrote his famous third law in 1973, in a revision of the 1962 essay "Hazards of Prophecy: The Failure of Imagination."
[106] Ligier, *Nicolas Schöffer*, 28.

retro-active, receiving and transmitting, omnidirectional and random, but above all omnipresent and limitless."[107] Space, light, and time for Schöffer were not themes or inspirations for his work; these were his materials, and technology merely a tool to manipulate them. "After the etcher's needle, the chisel, the modeling [sic] of heavy materials, we now have electricity and electronics, the modeling [sic] of weightless and immaterial substances, such as space, light, and time,"[108] reads the first entry on cybernetics in the Habasque and Ménétrier monograph. This mentality alone might be viewed as a sort of God complex, an attempt to know matters of the universe as a mere mortal. Of further interest is how this sweeping plan to manipulate the most fundamental of all elements resulted in objects that were, in so many ways, an exercise in not knowing. Later on, in 1975, Frank Popper referred to cybernetics as "a phantasmagoric source of inspiration"[109] for Schöffer – bringing the transcendent genius back to earth – and this, too, pushes us further away from understanding the nuances between knowing and not knowing in Schöffer's practice. In this example, the materiality of information and knowledge itself, or the processes through which it comes to inhabit one individual and their work, is turned into a phantom trace. What this language of deities, or sorcerers, or ghosts effectively does to Schöffer's history is sever it from its own material sediment, the archaeological patterns that history must show itself capable of unearthing. Jack Burnham, an amateur critic who nonetheless became quite famous for his work to document "systems aesthetics" and the increasing role of technology in art, considers Schöffer as pursuing "objectlessness, the manipulation of pure energy fields which materialize themselves."[110] But, Schöffer's objects were the opposite of invisible, or immaterial, and Burnham's suggestion that they materialize themselves overlooks the specialized labour required to keep them running. Spirit and matter are resolutely intertwined in his work—so, within a literature that calls upon the spirit, where, or perhaps what, is the matter?

Not all those who have documented Schöffer's work and described it for the masses focus on its magical qualities. The physicality of Schöffer's cybernetic projects does make its way into the literature, and occasionally one can find technical articulations of how the artist's machines operate. The entries in *Space, Light, Time*, even though they are firmly entrenched in a

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[107] Schöffer, "Microtime," 153.
[108] Habasque and Ménétrier, *Nicolas Schöffer*, 42.
[109] Popper, *Action and Participation*, 225.
[110] Jack Burnham, *Beyond Modern Sculpture: The Effects of Science and Technology on the Sculpture of This Century* (New York: George Braziller, 1968), 343.

language of magic and fantasy, nonetheless make an appreciable effort to overview the electronics used in Schöffer's works. Habasque and Ménétrier tell us, for example, that the "electronic brain" built by engineer Jacques Bureau included microphones, photoelectric cells, and a rheostat to register information about the surrounding environment. Notably, these parts of the "brain" are identified without any detail provided around thresholds of response, which has been a primary critique of mine—and the variations of the "brain" between projects are suggested in the texts but not clearly stated. Bureau has his own entry in the book, as well, didactically titled "Note on the homeostat produced by the Philips Company for the International Building and Public Works Exhibition, Paris 1955," though there is disappointingly little information provided by Bureau that is not available elsewhere in the volume.[111] A more recent example of close writing on Schöffer's technology worth recognizing here is Frédéric Schnee's 2018 essay for *ARPA* Journal, "Towards Dematerialization," which focuses on another of the artist's collaborations with Philips, the *Maison Spatiodynamique à Cloisons Invisibles*.[112] As the author's title indicates, though, the critical penchant for an exaggerated refusal of technological materiality still persists in our vocabulary. Perhaps of some relevance, Schnee's text is also one of the only texts I have been able to find that correctly specifies Schöffer's partnership with Philips Société Anonyme, versus the more frequent, broad reference to Philips Company or Philips Company Europe. More commonly than authors focusing on Schöffer's technology and its functionality, however, the physicality of Schöffer's machines is reduced to a question of movement or system. And these questions, somewhat conveniently, correspond to two major trends in art practice that paralleled Schöffer's own: kineticism and conceptualism.

A large majority of the writing on Schöffer's art appears in books, including Popper's *Art, Action and Participation*, that are tracking the much broader artistic movements of kineticism and conceptualism. For example, Schöffer's artwork features prominently in *Four Essays on Kinetic Art* from 1966, written by Popper, Stephen Bann, Reg Gadney, and Philip Steadman. Popper canonizes Schöffer as a kinetic artist in "Kinetic Art: Yesterday, Today, and Tomorrow." Steadman incorporates Schöffer's *Musiscope* into his essay on "Colour Music."

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[111] In seeking out a more precise account of the "brain," I came across A. H. Bruinsma's title *Practical Robot Circuits*: *Electronic Sensory Organs and Nerve Systems*, published by Macmillan/Philips Technical Company in 1960, though failed to find a publicly available copy. The book can be bought from a rare books store in the United States for the low, low price of $550.00 USD. I mention this only to prove how quickly such information becomes inaccessible to an average user or researcher.

[112] Schnee, "Towards Dematerialization".

Bann's contribution "Unity and Diversity in Kinetic Art" openly waffles on the meaning of kinetic art, and claims that spectators of Schöffer's works are engaging with time over movement,[113] implicitly denouncing the materiality of Schöffer's machines. Gadney offers the most thorough assessment of Schöffer's practice, in an essay that highlights Schöffer and Frank Malina as case studies for technical, kinetic artists. (Malina was actually an aeronautical engineer before he was an artist, and Gadney's grouping of Malina and Schöffer feels to me one of the most fruitful in the book, in that he has limited his scope to two artists working with motors and electronics.) Gadney also indicates his own suspicion of the kinetic category of art, writing therefore: "I think it is important that we should notice the somewhat disguised weakness in the term kinetic art when it can embrace styles as widely different as those incorporating a basically static composition […] and those using a mobile compositional basis."[114] This question of how to differentiate actual and virtual movement runs throughout the four essays. However, Gadney still falls into the traps/tropes of the modern critic, in moments like when he declares that "[Schöffer's] work in its absolute form exists not when static but in motion."[115] From the future perspective, it is not their absolute form but their multiplicity of form and adaptability to environment that gives them their meaning.

Four Essays points to the fact that kinetic art was caught between modern art theory and an emerging discourse of environment and spectacle. Similarly, Popper's *Art, Action and Participation* is an attempt to make sense of the emerging discourses of total environments and spectacle, following an earlier book dedicated solely to kinetic art.[116] In an article focusing on the activities of the Groupe de Recherche d'Art Visuel (GRAV), art historian Larry Busbea has observed how "kineticism itself maintained at best a metaphorical relationship with its true raison d'être: the highly charged spaces of the modern environment."[117] Schöffer's art was wrapped up in these ambiguous frameworks for a new, social art as well as "the ascendant cybernetic vocabulary of the time,"[118] resulting in a confusion of categories. In the context of Schöffer's robotic works, I see a need for an entirely separate stream of thought. If a mobile constitutes actual movement, then a motor surely deserves its own distinction, as does the

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[113] Stephen Bann, Reg Gadney, Frank Popper, and Philip Steadman, *Four Essays on Kinetic Art* (St. Albans: Motion Books, 1966), 59.

[114] Bann, Gadney, Popper, and Steadman, *Four Essays*, 37.

[115] Bann, Gadney, Popper, and Steadman, *Four Essays*, 33.

[116] Frank Popper, *Origins and Development of Kinetic Art* (New York: New York Graphic Society, 1968).

[117] Busbea, "Kineticism-Spectacle-Environment," 95.

[118] Busbea, "Kineticism-Spectacle-Environment," 94.

motorized and also responsive object that comes after it. The role of environment increases. And yet even where Schöffer's works do get acknowledged for their integration with environment, a different type of material erasure takes place. Instead of the machine being reduced to its movement, it is instead reduced to the "systems aesthetic," theorized most famously by Jack Burnham.

Burnham published his defining essay on systems art in *Artforum* in 1968—the same year as the *Cybernetic Serendipity* exhibition, curated by Jasia Reichardt for the Institute of Contemporary Arts, London, which is historically the first and one of the only curatorial projects that dedicated itself to cybernetics and art. In his "Systems Esthetics [sic]" essay, Burnham observes that "The systems approach goes beyond a concern with staged environments and happenings; it deals in a revolutionary fashion with the larger problem of boundary concepts."[119] This is undeniably true of Schöffer's cybernetic objects, and I have used the material stages of his towers to illustrate the impossibility of ascribing a boundary to their bodies. According to Burnham, however: "Conceptual focus rather than material limits define the system."[120] In *Beyond Modern Sculpture*, published the same year, Burnham wrote that Schöffer agreed with him on this point. "As an ardent exponent of the ephemerality of systems," writes Burnham, "Schöffer admitted that he often felt greatly hindered by having to use materials and manipulate them in the traditional sense of craft."[121] To acknowledge that material limits define the system is not to say that the system is enclosed or fixed, however, but rather that it has edges that eventually, always meet something else. A limit is about touch, the line between one body and something else's. Difference, then, can only be understood through the material lives of beings and things, not through their concept, which if not material then occurs as a symbolic or linguistic abstraction that is far too vulnerable to misrepresentation and misunderstanding. Shortly thereafter in the book, Burnham even undermines his own position when he states that "Neither Schöffer's sculptures nor his attempts at architecture are the results of a personal *style consciousness* deliberately imposed; they result from working with the technological limitations of the present age."[122] The machinic system – as with all systems, I would argue – is defined precisely through its material limit, a burden Schöffer's machines bore as early as the 1950s. In

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[119] Jack Burnham, "Systems Esthetics," *Artforum* 7, no. 1 (1968): 32.
[120] Burnham, "Systems Esthetics," 32.
[121] Burnham, *Beyond Modern Sculpture*, 343.
[122] Burnham, *Beyond Modern Sculpture*, 342.

the language of kineticism and conceptualism, then, we see the obfuscation that forms between the aversion to "boundary concepts" demonstrated by Schöffer's objects and at the same time, the importance of material limit to their performance both as an object and object of study.

The most obvious and persistent linguistic holdover from the early computational era, which is equally prevalent in current methods of articulating machines, is the conflation of human and machine through metaphor. It is not difficult to sense the growing pains of twentieth-century industry in historical writing about Schöffer's work. The rise of mass production created the ideal conditions for comparisons between humans and their robotic counterparts, and the Second World War and the Cold War both contributed to the unease around the latent power in machines. Suddenly, the machine was an increasingly prevalent threat to humankind, and this threat level rose dramatically in the context of computation. Where historically, machines had replaced and exceeded the physical power of the human body, the human mind remained metaphorically untouched as what separated us not only from robots, but from other animals and living beings. The rise of cybernetics was significant, then, in that it established the aim of computation to simulate the human nervous system. Norbert Wiener's *Cybernetics* is essentially a treatise on the similarities of the human and the computing machine. "We are beginning to see," he writes, "that such important elements as the neurons, the atoms of the nervous complex of our body, do their work under much the same conditions as vacuum tubes."[123] This is the beginning of a long passage comparing humans and machines, but, before quoting it further, it is worth mentioning that in order for Wiener to make this comparison it requires an erasure of difference in human bodies—in this passage, humans collectively share one body, "our body," something that even contemporary scholars of technology struggle to overcome in attempting to describe relationships between machine and human. That is, the performance of machine is assessed against one body—a body that in turn will become normalized as a standard. Wiener continues: "We deal with automata effectively coupled to the external world, not merely by their energy flow, their metabolism, but also by a flow of impressions, of incoming messages, and of the actions of outgoing messages. The organs by which impressions are received are the equivalents of the human and animal sense organs."[124] Schöffer and his collaborators were more than happy to embrace this cybernetic parallel of human and machine, stating "Spatiodynamic

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[123] Wiener, *Cybernetics*, 42.
[124] Wiener, *Cybernetics*, 42.

sculpture will make it possible, for the first time ever, to replace a human with an independently functioning abstract artwork."[125]

Admittedly, not everyone in the 1960s proved willing to draw such an equivalence between humans and machines, or at least not as a measure of specificity or uniqueness. In *Beyond Modern Sculpture*, Burnham observes that "sculpture has always been anthropomorphic,"[126] and expresses his concern for what he perceives as sculpture's increasing resemblance of life: "Sculpture seeks its own obliteration by moving toward integration with the intelligent life forms it has always imitated."[127] Burnham's approach to sculpture's mechanization reflected dominant attitudes about computation in general, including his own. "Indeed, like many intellectuals in the 1960s," writes Edward A. Shanken, "[Burnham] feared that the cultural obsession with, and faith in, science and technology, would lead to the demise of human civilization. For Burnham, the apocalypse would not be caused by thermonuclear war but by the ascendancy of intelligent automata and cyborgs."[128] Regardless of his decrying of the intelligent machine, however, Burnham was equally susceptible to the biological language being used to describe cybernetic devices. Looking at Ross Ashby's development of the homeostat, and its documentation in Ashby's *Design for a Brain* from 1954 (a safe guess as to where Philips engineers may have derived the name for Schöffer's electronics), Burnham expresses awe more than fear of what the device can do: "Brain may be an oversimplification of the homeostat's true accomplishment," he writes, "but it does suggest how this complex organ handles large quantities of incoming random information."[129] This hardly reads as the writing of a technological doomsayer. I have to believe that Burnham's suggestion that the word "brain" is too simple for the homeostat is not rooted in the belief that the homeostat is more complex than the human brain, but rather that the word "brain" does little to describe the precise functionality of the homeostat. These types of slippages in language, whether it's the language of magic or movements or human and machine metaphors, have come to not only determine the histories of art, science, and technology but also the ways they continue to be understood. Research psychologist Michael J. Apter's 1969 article "Cybernetics and Art," published in the definitive

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[125] Note on *CYSP 1* released by Nicolas Schöffer and Philips Société Anonyme quoted in Pierre, Trudel, and Mari, *Nicolas Schöffer*, 67.

[126] Burnham, *Beyond Modern Sculpture*, 332.

[127] Burnham, *Beyond Modern Sculpture*, 333.

[128] Edward Shanken, "Historicizing Art and Technology: Forging a Method, Firing a Canon," in *MediaArtHistories*, ed. Oliver Grau (Cambridge, MA: MIT Press, 2007), 50.

[129] Burnham, *Beyond Modern Sculpture*, 337.

publication for art, science, and technology, *Leonardo*, considers that "[f]or centuries, people have been able to argue there is a fundamental difference between living and non-living entities in that animals, including man, are able to be purposeful, to act toward the future in some mysterious way."[130] Apter goes on to compare animal and machine behaviour, stating that not only does machine behaviour show purpose in the twentieth century but that "Purposeful behaviour by animal or machine can be explained in identical 'cause-and-effect' terms."[131] No matter what side of the debate you fall on, believing in machines' equivalence to animals or believing in a fundamental difference between the two, one thing is for sure: machines that respond in real time to environmental factors, whether they are art objects or otherwise, demand that we address them on their own terms. It can't just be sculpture. The satisfying simplicity of this fact will drive us forward in the search for methodological approaches up to the task of documenting these robotic bodies that – though we may not know exactly how to grasp them – are proven capable of changing the terms of our engagement.

3 Troubleshoot: Filling a Historiographic Vacancy

In the previous two sections I have attempted to demonstrate that not only language, but the persistent chronologies of time and history obscure a more complete understanding of Schöffer's art. I propose that the language conferred to the artworks during their period of production, and ongoing tendencies to historicize them even in their evolved states, defy the multiplied materialities of Schöffer's machines—unbuilt, temporary, restored, and all the infinite states not discussed here. Yet the apparent difficulties encountered by writers of art, science, and technology are not supported by the type of reflection that may guide our navigation into the explosion of responsive, technological art forms existing today. That is, throughout the scattered origins of cybernetic art history that Nicolas Schöffer's practice helps us to trace, I have seen that the little amount of writing done around media art has been backed up by an even smaller amount of historiographical writing designed to assess it. Edward Shanken's "Historicizing Art and Technology: Forging a Method and Firing a Canon" argues exactly this, clarifying the point of contention as such: "The canon of Western art history has not placed sufficient emphasis on the centrality of science and technology as co-conspirators, ideational sources, and/or artistic

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[130] Michael J. Apter, "Cybernetics and Art," *Leonardo* 2, no. 3 (1969): 260.
[131] Apter, "Cybernetics and Art," 260.

media. Bound up in this problem is the fact that no clearly defined method exists for analyzing the role of science and technology in the history of art."[132] Shanken grapples with the contributions of Jack Burnham and *Beyond Modern Sculpture,* for instance, as one of the only texts that attempted to reflexively analyze sculpture's increasingly mechanical and technological form. For all its flaws, *Beyond Modern Sculpture* remains one of the only books dedicated to tracing art, science, and technology overlaps during the rise of computation, when relationships between these disciplines became formalized for the first time through partnerships such as the one Schöffer had with Philips, or those between Bell Labs engineers and Experiments in Art and Technology (or E.A.T.).[133] Though he is quick to acknowledge the errors in Burnham's account, Shanken nonetheless believes that scholars in this area are required to pay attention to it, and other past attempts to document intersections between art, science, and technology—or what he refers to shorthand as "AST". Shanken writes: "At this formative juncture in establishing the histories of media art, science, and technology, perhaps artists, critics, and historians would do well to purge their methodological prejudices, scour retrograde methods like […] Burnham's, and create synthetic, interdisciplinary approaches to analysis, interpretation, and exposition."[134] Shanken's article resonates with my analysis of an imperfect artist and his imperfect objects, in order to better understand the currents that moved them and find new ways to put their imperfection in words. Thus far, I have sought to describe the materialities of Schöffer's objects, and observe the ways his materialities got caught in the nets of history and of writing. Here, in this thesis' concluding section (followed only by a brief, speculative take on cybernetics as one possible art-historical methodology) I provide an overview of historiographical and methodological questions that have been raised around studies in art, science, and technology.

The frequent exclusion of media art histories from the art-historical canon, as identified by Shanken and others, could be partially explained by something as simple as its relative newness. Art historian Linda Dalrymple Henderson, who wrote what Shanken calls "the only historiographical analysis of writing about AST,"[135] says therein: "The first extended discussions of historical connections between modern art and science appeared in the 1940s. More general

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[132] Shanken, "Historicizing Art and Technology," 44.
[133] Experiments in Art and Technology was a non-profit organization dedicated to connecting artists with engineers, in an effort to facilitate art, science, and technology collaboration and increase artists' impact in the social sphere. The organization was started in 1967 in New York City and its activities continued into the 2000s.
[134] Shanken, "Historicizing Art and Technology," 48.
[135] Shanken, "Historicizing Art and Technology," 45.

analyses of the relations of science and the humanities had a longer history – especially in Britain – but World War II and the atomic bomb brought this topic to the fore with a new kind of urgency."[136] It was precisely this same context that gave birth to Norbert Wiener's cybernetics, and the notion of a science that would fill "the no-man's land between the various established fields."[137] In "Creativity, Technology, and the Arts," John Cohen's contribution to the 1971 *Cybernetics, Art, and Ideas* anthology – edited by Jasia Reichardt and published as an outgrowth of her 1968 *Cybernetic Serendipity* exhibition – the author provides a view from the inside of the shifting disciplinary landscape of the arts and sciences: "Technology as we understand it in our own time is vastly different from the technology of antiquity, the Middle Ages, or the renaissance, interwoven as it was then with art and science."[138] Using examples from centuries prior including hydraulic fountains and automata, Cohen considers how the bifurcation of art and science had not always been present in the public's imagination.[139] His point supports Dalrymple's in its insinuation that the twentieth century brought about a specific mentality around art, science, and technology. Perhaps this is why scholarship in this area had been so slow to emerge—where earlier relationships between the three fields had been taken for granted, and the twentieth century's interest in re-evaluating those relationships was borne of very particular and contested circumstances. The unease around machines increased as a result of their increasing likeliness to humans, and, as Apter and other authors identified, in the centuries prior to the 1900s humans were better able to maintain their uniqueness – and, subsequently, a feeling of superiority – over other beings. It is true that Apter and Cohen are writing from a similar position, and attempting to understand the significance of their time from within it. Their work might be taken with the idiomatic grain of salt, much like the writing on Schöffer by contemporaneous critics. At the same time, intellectuals such as Donna J. Haraway only began to expound on the notion of the "posthuman" in the 1980s, drawing on precisely the period that this thesis concerns itself with—the establishment of cybernetics as a field. Therefore, there is a case to be made that, although art, science, and technology always intersected and overlapped, these had not been acknowledged as presenting a unique set of concerns for art historians prior to the

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[136] Linda Dalrymple Henderson, "Editor's Introduction: I. Writing Modern Art and Science – An Overview; II. Cubism, Futurism, and Ether Physics in the Early Twentieth Century," *Science in Context* 17, no. 4 (2004): 429.

[137] Wiener, *Cybernetics*, 28.

[138] See John Cohen, "Creativity, Technology, and the Arts," in *Cybernetics*, *Art*, *and Ideas*, ed. Jasia Reichardt (Greenwich/London: New York Graphics Society/London: Studio Vista, 1971), 31-32.

[139] Cohen, "Creativity," 31.

period that concerns this thesis. In other words, art, science, and technology had not yet coalesced into AST. The scattered origins of cybernetic art history therefore map directly onto the origins of art, science, and technology as we understand it in the twenty-first century. In addition to being one of the reasons AST has been less thoroughly addressed by art history, this is also one of the reasons that cybernetics holds potential as an art-historical framework for AST.

The discourse around art, science, and technology as it emerged in the twentieth century might not have reflected long-held attitudes about the three fields and their relations, but writers then and since have been quick to point out a long-held imbalance between the two. In his article from 1971, Cohen observes that "somehow we are more apt to note the influence of science on the arts than the influence of the arts upon science."[140] Dalrymple Henderson, years later in 2004, presents an idea nearly identical in concept if not in words: "[T]he impact of art on science has always been the direction less discussed."[141] These claims are definitely proven true in the case of Schöffer, whose electronic brain was built by Philips' Jacques Bureau less than ten years after its predecessor, Ross Ashby's homeostat—and yet the value or significance of his work was always put in art-historical terms, and his vested interest in science and technology was dismissed by so-called hard scientists like cybernetics' founder Norbert Wiener. The noted disparity in how the arts are viewed against the science and technology sectors would come as no surprise to most working on AST projects in the arts today, or anybody I know in the arts generally. Even before I had started researching the topic of this thesis, I was introduced to the interdisciplinary dilemma at the Re:CREATE Media Art Histories conference in 2015, hosted by Concordia University and Université du Québec à Montréal, through a panel on "challenges, best practices, and the future of transdisciplinary collaboration in media art, science, and technology." On the arts side, it was felt that scientists had more legitimacy, and arguably more respect, when producing work of the same nature; but, the scientist on the panel, Francois Joseph-Lapointe from the Quebec Centre for Biodiversity Science, was quick to point out a gap in recognition when expertise from the sciences often qualifies as invisible labour behind the artist's name.[142] Presumably, both the arts and sciences have a claim to the labour it takes to teach those from other disciplines about your own. No wonder art, science, and technology has struggled to

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[140] Cohen, "Creativity," 32.
[141] Dalrymple Henderson, "Editor's Introduction," 433.
[142] Louise Poissant, Ruth West, Roger Malina, Sara Diamond, and Francois Joseph-Lapointe, "Challenges, Best Practices, and the Future of Transdisciplinary Collaboration in Media Art, Science, and Technology" (panel discussion, MediaArtHistories conference, Montreal, QC, November 8, 2015).

develop a more coherent structure when not only its value, but the very possibility of mutually productive collaboration stands to question. In *Art, Action and Participation*, published first in 1975, Popper asked "whether interdisciplinary creativity is actually feasible,"[143] and here we are in the 2010s asking ourselves the same questions. The identity of art, science, and technology has been developed on shaky ground from the start. This may not be inherently damaging to scholars in the field, but, as Shanken has suggested, does create an added question around the sustainability of this research in the institution. He closes his "Historicizing Art and Technology" article as follows: "On a practical level, the future sustainability of hybrid research depends on answering these questions, because the academic careers of scholars whose work fuses disciplines will be cut short if their contributions are not recognized and rewarded within the university."[144] The marginalization of art, science, and technology cannot be equated with the marginalization of scholars working in race/postcolonial or queer theory, for instance—but I see an opportunity to shift our thinking around machines in ways that benefit both. I speak more to the relations between art, science, and technology and upholding a sense of political responsibility in the conclusion.

Interestingly, when discussing AST interdisciplinarity, science and technology are always grouped together conceptually as not-art, when the priorities of art and science practitioners are distinct from those of art and technology practitioners. Dalrymple's article is undeniably a valuable starting point for anyone entering art, science, and technology research—but it nonetheless places emphasis on science over technology. (And yet Shanken highlights it in his discussion of art, science, and technology as the only historiographical text of its kind.) Research methodologies dedicated to art, science, and technology must, then, be able to move between science and technology as independent fields at the same time as acknowledging their relative historical similarities next to the arts. Again, cybernetics holds potential here as a methodological framework. Even though its possible applications to the arts were not immediately recognized by Norbert Wiener, he did provide a case for the value of interdisciplinarity in *Cybernetics,* be it in oblique terms. He uses the example of a mathematician and a physiologist attempting to solve a problem that is "physiological, but mathematic in essence,"[145] writing thusly: "If a physiologist who knows no mathematics works together with a mathematician who knows no physiology, the

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[143] Popper, *Action and Participation*, 207.
[144] Shanken, "Historicizing Art and Technology," 66.
[145] Wiener, *Cybernetics*, 2.

one will be unable to state his problem in terms that the other can manipulate, and the second will be unable to put the answers in any form that the first can understand."[146] This hypothetical helps to show the benefits of AST scholars from different disciplines sharing vocabulary about art, science, and technology—essentially establishing a shared language, instead of trying to translate. Cybernetics' broad applications do not always lend to increased criticality in language, though. Michael J. Apter attempted to unpack the various uses and applications of cybernetics, and their integration with art, in 1969—the peak period for the artists, artworks, and other AST history discussed here. Though Apter later became a scholar of psychology rather than cybernetics, he provides a valuable summation of how terminology can confuse rather than clarify conversations about cybernetic art. Apter writes:

> The term 'cybernetics' is one which refers to a number of related tendencies in science and mathematics, to a number of developing areas and techniques which overlap each other in different ways. The situation is further confused by the emergence of a host of new names to refer to many of these overlapping areas: information theory, communication theory, servo-mechanics, control theory, automata theory, computer science, artificial intelligence, bionics, automation, cybernation and so on.[147]

The seemingly endless applications of cybernetics establish its potential as a broad enough frame to turn into a methodological framework for writing about machines at the same time it empties the word of meaning. Cybernetics, as a field of inquiry, is therefore no longer applicable to a specific category of objects. What cybernetics might do for art today is point to a vocabulary and a set of qualifying questions designed to identify the specific materialities of responsive machines built by different means and methods. The fact cybernetics can be considered in scientific and technological terms, encompassing and ultimately growing into innumerable disciplines where animals and machines come together, allows it an intellectual or academic adaptability that mimics the adaptable infrastructures it was initially developed to design and control. Cybernetics' exponential broadening since the terms' first use in 1947 lends to its interdisciplinarity, and brings us around to the point that the writing about cybernetic art was

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[146] Wiener, *Cybernetics*, 2-3.
[147] Apter, "Cybernetics and Art," 257.

rarely, itself, operating cybernetically. I can't help but wonder what a cybernetic method of writing – rather than writing about cybernetic methods – would look like. The key difficulties facing media art historians have largely centred on a lack of specificity, and rather than using cybernetics as a universal term for machines ranging wildly in their material qualities, I propose it can be used to the ends of better, more nuanced communication.

When it comes to developing strategies for critical, timely, nuanced, and specific communication, Nicolas Schöffer fails to overcome the "fantasy of transcending the political,"[148] which Yates McKee identifies as a common impulse for 1960s groups interested in cybernetics and its theories of self-regulation. Even though a close material analysis of Schöffer's machines offers opportunities to get outside the universalist symbolism they inspire, the artist himself was absorbed by the type of "abstract total communication"[149] that cybernetics' early articulations put forward as the tool, next to machines, that govern a system. Quoting French theorist Jean Baudrillard's critique of Schöffer's *Le nouvel esprit artistique* as the "biblical specimen" for "aesthetic operationalism,"[150] McKee summarizes that "[f]or Baudrillard, the universally applied project of cybernetics represented a depoliticization of aesthetic practices and social relations alike,"[151] creating conditions that "do not allow anything to exist outside the system."[152] This is one of the reasons why cybernetics cannot be left to operate in a vacuum. Looking for its critical function requires situating it in relationship to specific machines, and not society as a machine. McKee looks for this nuance of cybernetic communication as a tool for upholding a monolithic system at the same time it can circumvent it. He, though sensitive to Baudrillard's position, points out that resistance, in Baudrillard's view, opposes systems—but systems, and cybernetics, are capable of operating at different levels of communication. Resistance, McKee says, might deploy these alternative systems, taking new form as "a horizontally distributed network of subsystems that themselves could involve moments of productive dysfunction, disturbance, and transformation."[153] Cybernetics' qualifications as an interdisciplinary methodological framework are rooted in its capability to account for various types of machines and our experiences with them. The inevitability of dysfunction and disturbance in these machinic relations means that

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[148] McKee, "Public Sensorìums of Pulsa," 59.
[149] McKee, "Public Sensorìums of Pulsa," 58.
[150] Jean Baudrillard quoted in McKee, "Public Sensorìums of Pulsa," 58.
[151] McKee, "Public Sensorìums of Pulsa," 58.
[152] Baudrillard quoted in McKee, "Public Sensorìums of Pulsa," 58.
[153] McKee, "Public Sensorìums of Pulsa," 58.

vocabularies must possess their own transformational power, absorbing and accepting disturbance in the way the machine does, and viewing the disturbance as an integral part of our communications. In his theorization of cybernetics as "nonmodern ontology,"[154] Andrew Pickering picks up a similar thread to McKee, and observes how cybernetic systems "staged their own performative dances of agency, that foregrounded performance rather than treating it as some forgettable background to knowledge."[155] If we accept that knowledge is bound up with communication, and particularly knowledge in action, the approach to language as a system capable of its own dance of agency may offer a starting point for the development of a more coherent methodology. As this thesis' concluding thought, I sit with the generative meanings of performance—its significance to language, to machines, and to the relations of all human and other-than-human bodies.

In *Cybernetics*, Wiener states that "[t]he community extends only so far as the effectual transmission of information."[156] Language, like machines, only performs as intended when all the right information is there. Unlike machines, however, language will not always tell you right away when it is not working properly. The gaps in information throughout cybernetic art history are not only a matter of the field's lacking institutional support or interdisciplinary method, but a vocabulary that needs to be replaced with more flexible and adaptable terminology. Current writers on Schöffer have taken up terminology at higher levels; for example, Arnauld Pierre has discussed the language of "feedback" as preferable to "participation" in Schöffer's art, as a way of framing its responsive movements with more intention.[157] Pierre explains the origins for cybernetics' language in behaviorism, referring to members of Schöffer's audience as "human device[s]" that are managing input and output alongside his machines.[158] But humans are also interpretive devices, and although distinctions between participation and feedback are useful and important, what gets overlooked in exclusively qualifying the style of responsivity in human and machine interaction is our control over the terms. As participants we must assess our own performance alongside the performance of the machine, and language, but not necessarily alphabetical language, is part of the way we perform as well as assess performance. This

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[154] Pickering, *Cybernetic Brain,* 13.
[155] Pickering, *Cybernetic Brain,* 381.
[156] Wiener, *Cybernetics,* 158.
[157] Arnauld Pierre, "L'oeil multiplié: l'extension cybernétique de la conscience perceptive," in *L'œil moteur. Art optique et cinétique 1950-1975* (exhibition catalogue, Musée d'Art moderne et contemporain de Strasbourg, 2005).
[158] Pierre, "L'oeil multiplié," 25-26.

troubleshoot for media art historiography leads us back to the question of how to analyze self-reflexively, and build unknowability into the writing, which is how writers of responsive machines will come to approximate the functionality of their subjects. In studying writing on Schöffer's works, and machine art in general, we therefore encounter "the struggle for language and the struggle against perfect communication, against the one code that translates all meaning perfectly."[159] The six sections of this thesis, broken up into two main parts, have interrogated the codes at play in Nicolas Schöffer's cybernetic machines. There is the code that runs the machine and those that determine its material life, as well as the linguistic and symbolic codes that determine our relationships to it. The main task of a methodology for interdisciplinary historians of art, science, and technology is to see how these codes interact to shape our machinic encounters. It is our duty as contributors to public discourse to leave space for specificity and difference in our writing, lest we forget that not all bodies are coded equal.

Conclusion: Executing the Program

This thesis has raised more questions than answers and more problems than solutions in the ways we write about machines. The most crucial and urgent of these problems lingers here, and that is how writing and possibly even more so methodology can reinforce the inequities between people working and existing in art, science and technology; the academy; everywhere locally and globally. It is not only machinic bodies that are not coded equal. Quite oppositely, the linguistic codes and corresponding categorizations that define how humans exist and interact with one another have seeped their way into the frames for our other-than-human counterparts. Since Schöffer's "robot dancer," science and technology have crept closer and closer to actual humanoids that can look, act, and possibly even think like the real thing. Mainstream media has started to explore empathy for machines as a defining issue of our times, through television shows such as HBO's *Westworld* or Netflix's *Black Mirror*. Sometimes, as writer Pedro Neves Marques has recently pointed out in an analysis of the AI-based robot Sophia, this increasing ability to identify with machines as they become codified in new ways has the potential to negatively affect the ongoing struggle for human rights globally. Referring to Sophia's new status as a citizen of Saudi Arabia, Marques states the point: "If you're a well-intentioned futurist, perhaps you're glad that her recently acquired citizenship may bring her closer to

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[159] Haraway, *Simians, Cyborgs, and Women,* 176.

humanity, but consider also that empathy towards robots need not equate robots to humans for their rights to be asserted."[160] The risk, Marques is telling us, lies in allowing the individual rights of robots to exceed those of some humans. Bluntly, our priorities are not in check. The question of what it means to write machines responsibly is therefore not a matter of theory, nor a theory of matter, but a rhetorical observation of the production of codified difference across human and other-than-human bodies. Feedback is not reducible to input and output, and machines are deeply political. Just as the media art historian and scholars of technology in general should be wary of overlooking the specific functionality and materiality of individual machines, there is a deeper question at hand about why and how machines come to matter. Wendy Hui Kyong Chun has staged a critique of this neutralized approach to machine empathy, as follows:

> That the humanities and cultural theory more generally have moved away from questions of cultural difference and identity at a time when such an engagement could not be more crucial is mind-boggling. The various turns toward "less coarse" and "static" concepts such as nonhuman allure (themselves inspired by networks and new media), not to mention the embrace of an instrumentalist technological logic that demeans critical analysis and celebrates digital tinkering, are oddly contradictory and self-defeating.[161]

One of the important lessons to be taken from Marques, Chun, and others doing work in critical technology studies is not to implement the broad concept of the nonhuman to our studies of machines because it makes permissible the universal human subject on the other side. In industry terms, this problematic ideal might be packaged as an ideal user. This figure can be especially prevalent in art history, where the viewer, user, or participant of the work of art is always a factor in how the object is gauged and measured. When the object is a responsive machine that is acting on its environment and other beings, the need for clear and nuanced communication is amplified. This study of Schöffer has illustrated just how much information can be left out in analyses of machines designed for collective experience and engagement. I am left wondering whether, for example, someone using a wheelchair would be able to establish feedback with *CYSP 1* as the

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[160] Pedro Neves Marques, "Sophia, with Love and Hate," *The Baffler,* November 14, 2017, https://thebaffler.com/latest/sophia-with-love-and-hate-marques.

[161] Wendy Hui Kyong Chun, "Queerying Homophily," in *Pattern Discrimination*, by Clemens Apprich, Wendy Hui Kyong Chun, Florian Cramer, and Hito Steyerl, 51-97 (Cambridge: MIT Press, 2018), 89.

able-bodied ballerinas did. I am wondering, too, how our language can become more accessible, allowing for more productive forms of criticism.

After researching cybernetic art histories, I believe a methodological framework grounded in cybernetics could encourage media art historians to ask the right questions about their objects. Cybernetics, as it was understood by Norbert Wiener and its other founding fathers, has gone through its own coming-of-age thanks to Donna Haraway, Katherine Hayles, and other scholars of feminist technoscience. Historians such as Andrew Pickering who have tracked alternative, experimental iterations of cybernetic inquiry have also contributed to its fresh image, one that is inclined toward less controlled environments. Cybernetics' growth into "an ontology of unknowability and becoming"[162] offers it potential as a new way of thinking around machines. Concerned with users, environments, and performance (both in terms of functionality and theatrics), a cybernetic approach might inspire more specific questions about machine feedback. For example: "To what extent can the machine respond to x?" (a question that can only be answered by observing the unique technical capacities of a machine) leads us to consider more carefully the relationship between machinic objects and their users and environments. Hardly a call for a formalist revival, this materially-derived method is specifically useful to technological art forms because of their requirement of receiving ongoing material updates. The threshold of responsivity can always change, as Schöffer's machines prove. The media art history methodology I pursue does not seek to define machines through their material exterior – colour, line, form – but their material interior, the very wiring and hardware that allows machines to act various ways. This approach should not be considered mutually exclusive from the politics that determine how bodies move through space and absorb cultural phenomena. By homing in on the material specificity of these objects, especially those designed to respond or interact with an audience, the intention is to better understand the specificity of a given object's reaction to particular bodies. A strong example for this in the history of visual culture and technology is early Kodak cameras that were incapable of picking up on darker skin tones.[163] Understanding to what and whom technologies are equipped to respond is an important step in understanding their

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[162] Pickering, *Cybernetic Brain,* 33.

[163] Kodak introduced the infamous "Shirley card" to assist with light balancing; Shirley was white, and by using her to determine the standard and quality of photography, Kodak consistently built cameras ineffective at picking up on darker skin tones. This continued until they updated their colour card in 1996 to include people of colour. For a deeper analysis of Shirley, see Lorna Roth, "Looking at Shirley, the Ultimate Norm: Colour Balance, Image Technologies, and Cognitive Equity," *Canadian Journal of Communication* 64 (2008): 111-136.

political impact. Following this thought, I see this proposed approach to media art history as aligned with feminist and decolonial imperatives.

The body of research presented in this thesis reflects an effort to better understand why we talk about machines the way we do. Nicolas Schöffer provided a perfect example with which to identify and articulate the problems inherent in modern metaphors for technology. As an artist whose politics seemed almost at odds with the material lives of his machines, he also points to the misalignment that can occur between an artist and their objects. Machines are resolute in their materiality, and the artist's chosen messaging around his works, conceived in part with a corporation, should not be confused with their real-world functionality. By targeting Schöffer's complicated practice as a case study, the various interdisciplinary aspects of studying machines in art history are made plain. The tropes of our speech surrounding machines, such as human and machine metaphors, have roots in cybernetic histories. However, these codes have been applied without equal measures of technical vocabulary and the ability to assess the political resonances of technical limits. If a cybernetic methodology for writing media were to be developed, it would require a definition of cybernetics that allows for the technical specificity of early cybernetic experiments, and the politicized understanding of cybernetic bodies, language, and environments expressed in later feminist technoscience literature. Machines are increasingly significant parts of our global networks, and as scholars of the humanities, technology studies, and media art history continually assess and re-assess our relationships to machines, I look forward to doing more work toward refining the terms, limits, and intentions therein.
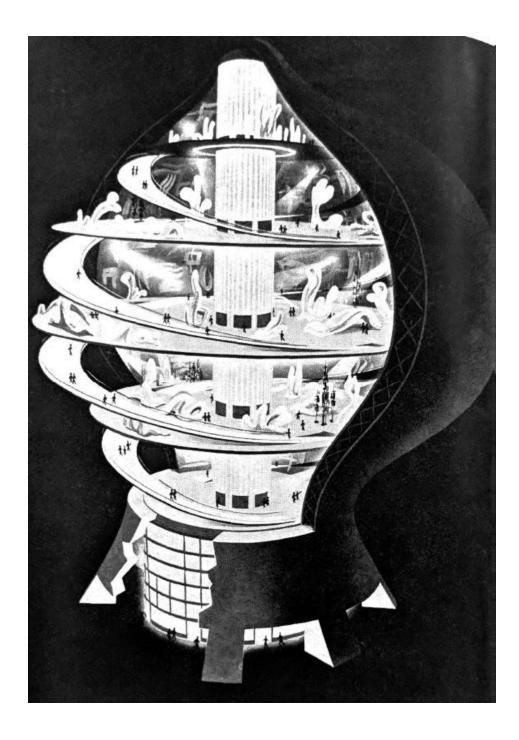
Figures

Fig. 1. Nicolas Schöffer, Centre for sexual recreation and leisure, printed in Nicolas Schöffer, *La ville cybernétique* (Paris: Denöel/Gonthier, 1969).
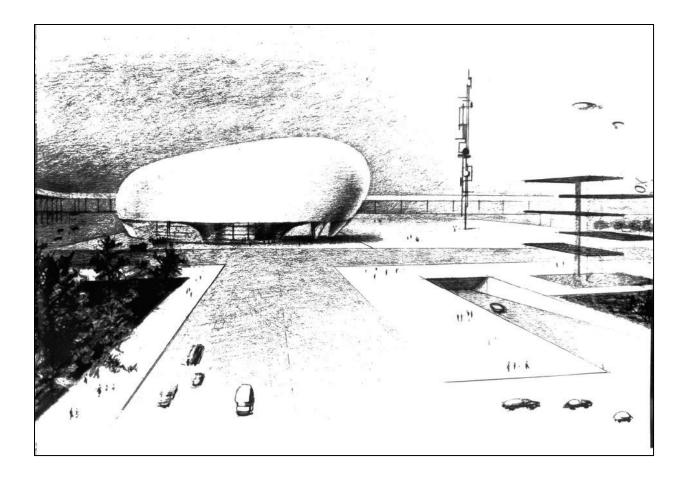
Fig. 2. Nicolas Schöffer, sketch for Théâtre Spatiodynamique dans son environnement urbain, 1956, printed in Maude Ligier, ed. *Nicolas Schöffer* (Paris: Les Presses du réel, 2004), 253.
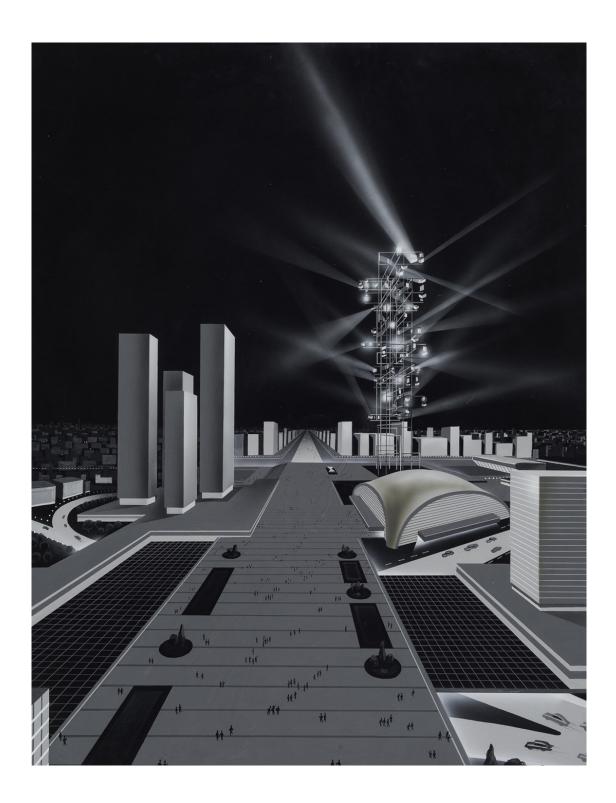
Fig. 3A. Nicolas Schöffer, *Tour Lumière Cybernétique de Paris-La Défense* in situ and illuminated, 1961, gouache. Collection of Éléonore de Lavandeyra-Schöffer, photo by N. Dewitte / LaM. © Adagp, Paris – Éléonore de Lavandeyra-Schöffer, 2018. Image source: https://hyperallergic.com/440598/nicolas-schoffer-retroprospective/.
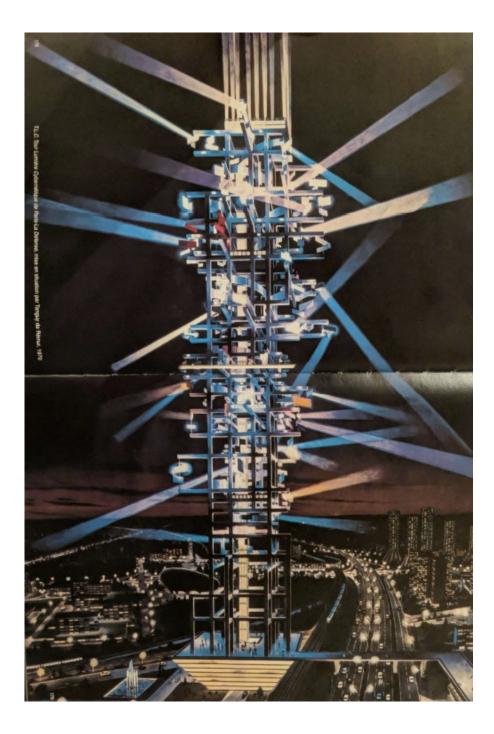
Fig. 3B. Nicolas Schöffer, *Tour Lumière Cybernétique de Paris-La Défense*, illustration by Tanguy de Rémur, 1970, printed in Maude Ligier, ed. *Nicolas Schöffer* (Paris: Les Presses du réel, 2004), 178.

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Fig. 4. Nicolas Schöffer, sketch for a cybernetic tower in Montreal. Photograph taken by the author in Nicolas Schöffer's archives, Villa des Arts, Paris. Courtesy of Éléonore de Lavandeyra-Schöffer.

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Fig. 5A. Archival cover for binder pages on Nicolas Schöffer's Montreal tower. Photographs taken by the author in Nicolas Schöffer's archives, Villa des Arts, Paris. Courtesy of Éléonore de Lavandeyra-Schöffer.

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Fig. 5A. Newspaper article (publication details unknown). Photographs taken by the author in Nicolas Schöffer's archives, Villa des Arts, Paris. Courtesy of Éléonore de Lavandeyra-Schöffer.

Fig. 6. Nicolas Schöffer, *Tour Spatiodynamique, Cybernétique, et Sonore* at the first Salon International des Travaux Publics et du Bâtiment at Parc du Domaine de Saint-Cloud, 1955. Courtesy of Eléonore de Lavandeyra-Schöffer. Image source: http://www.arpajournal.net/towards-dematerialization/.
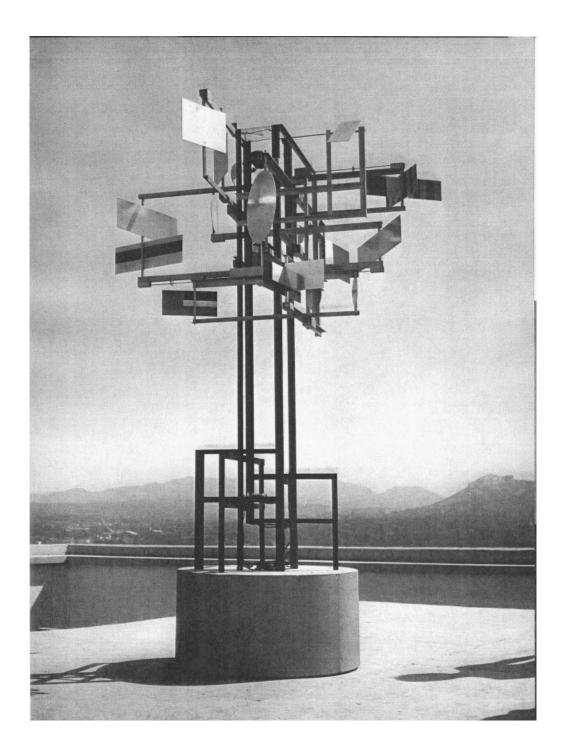
Fig. 7. Nicolas Schöffer, *CYSP 1*, 1956, pictured on top of Le Corbusier's Cité Radieuse in Marseille, printed in Guy Habasque and Jacques Ménétrier, *Nicolas Schöffer*, trans. Haakon Chevalier (Neuchâtel: Editions du Griffon, 1963).
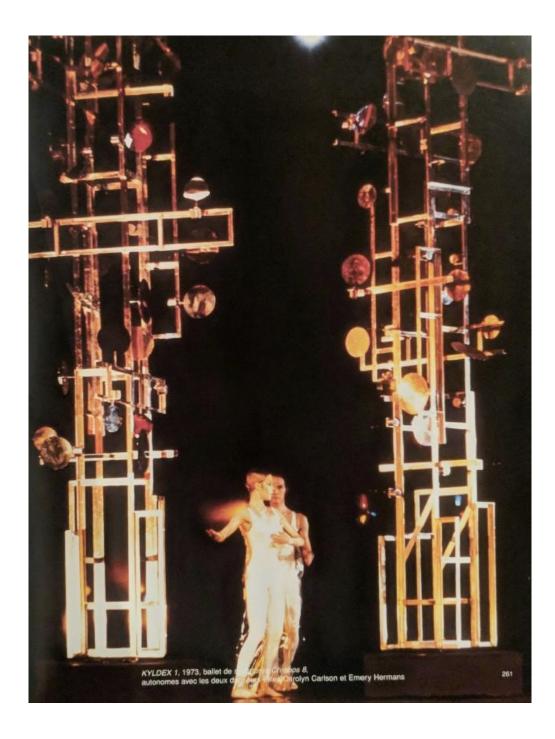
KYLDEX 1, 1973, ballet de ... *Chronos 8*,
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Fig. 8. *KLYDEX 1*, 1973, performance documentation, printed in Maude Ligier, ed. *Nicolas Schöffer* (Paris: Les Presses du réel, 2004), 261.
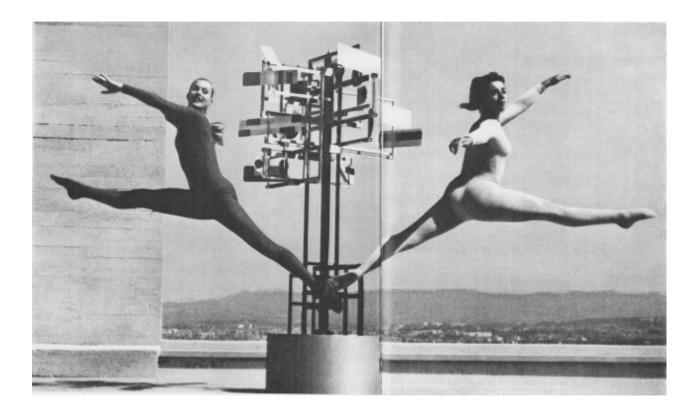
Fig. 9. *CYSP 1*, 1956, pictured on top of Le Corbusier's Cité Radieuse in Marseille. Documentation of 1956 ballet performance choreographed by Maurice Béjart, printed in Guy Habasque and Jacques Ménétrier, *Nicolas Schöffer*, trans. Haakon Chevalier (Neuchâtel: Editions du Griffon, 1963).
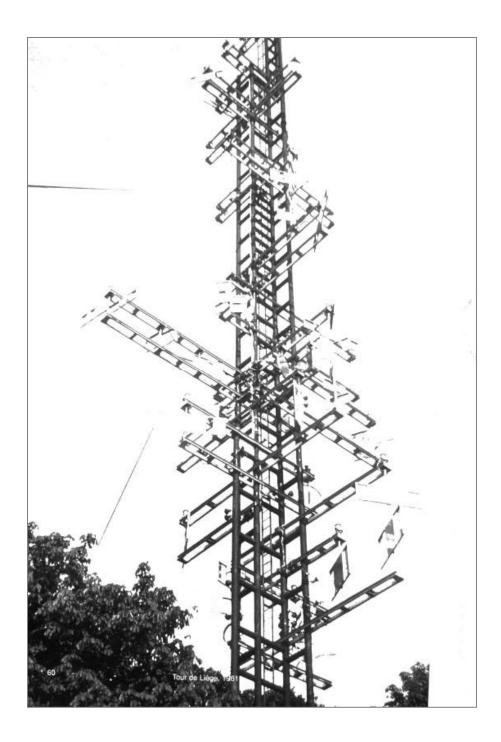
Fig. 10. Nicolas Schöffer, *Tour Spatiodynamique et Cybernétique de Liège*, 1961, printed in Maude Ligier, ed. *Nicolas Schöffer* (Paris: Les Presses du réel, 2004), 60.

Fig. 11. *Formes and Lumières* (or Forms and Lights), Palais des Congrès, Liège, 1961, printed in Maude Ligier, ed. *Nicolas Schöffer* (Paris: Les Presses du réel, 2004), 240.

Figs. 12A & B. Nicolas Schöffer**,** *Tour Spatiodynamique et Cybernétique de Liège*, 2016 restoration, City of Liège, Belgium. Photographs taken by the author in 2018.

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